REX

PUMPCRETE PRACTICE

A Manual of Concrete Placement by Pumpcrete—for Contractors, Engineers, Estimators and Operating Men

CHAIN BELT COMPANY

CONSTRUCTION EQUIPMENT DIVISION

MILWAUKEE, WISCONSIN

Manufacturers of

REX MIXERS ● REX PAVERS ● REX MOTO-MIXERS

REX SPEED PRIME PUMPS ● REX PUMPCRETE

INDEX

INTRODUCTION

Primarily this publication is intended for the use of contractors and engineers as an aid for job layouts and estimating placing costs. It is intended to acquaint inexperienced Pumpcrete users and those to whom the system is relatively new, with the fundamentals of sound and economical practice. It is intended to answer the question, "Is it a Pumpcrete job?"

In the latter respect, attention is chiefly concentrated on the smaller units, the Models 160 and 180 as cost cutting equipment for the average job of one, five or ten thousand yards where the profit margin is tight and close figures are in order.

For the purpose of more graphic illustration a number of actual jobs more or less typical of every day Pumpcrete experience have been outlined as fully as circumstances permit. To be of value, such data must be consistent with the accuracy demanded of its purpose. At the same time, customs and specifications still vary almost as widely as do concrete aggregates. So, in dealing with a subject as complex as general construction work, generalities will sometimes be the rule.

Observations and statements here and there may seem out of character with the spirit of pure analysis. However, we believe them relevant to the subject at hand because bare figures sometimes fail to complete a story. We can hardly profess a truly unbiased attitude, but we have confined the following estimates to an undeviating accuracy in that to the best of our knowledge, all statements as to performance and results have been exceeded in actual practice.

CHAPTER I THE PUMPCRETE METHOD

Questions Asked About Pumpcrete

Contractors and engineering organizations investigating the possibilities in Pumpcrete methods for the first time will ask: *How much does it cost and how can it be used to our financial advantage?* Some of the more common questions are listed as follows:

1—What is the initial cost?

2—What does it cost to place concrete by the Pumpcrete method?

3—What are its other advantages, if any?

4—Is the idea practical for my particular job?

5—Will it fit in with my present equipment?

6—What is its normal life? maintenance? is it a prima donna?

7—What type of plant setup is required? or preferable?

8—What kind of concrete will it pump?

9—What is its hourly capacity?

10—How far and to what height or combination of these distances, can concrete be pumped and under what conditions?

11—How is concrete to be distributed after it reaches the forms?

12—What is the cost of pipe handling and rigging?

13—How is its efficiency as a placing unit affected by extremes in weather conditions?

The following chapters answer the foregoing and other pertinent questions.

The Field for Pumpcrete

The Pumpcrete is not a panacea for construction ills. It is not the answer for every problem; *but,* given concrete specifications and working requisites within the prescribed limitations found in Chapters VIII and IX, any structure where direct placing costs will be appreciably lower than by other methods, or where its adaptability to local conditions can be converted into savings impossible of realization by other methods of placement, may be called *a Pumpcrete job.* A structure on which some other placing method can be employed to greater advantage from the economic standpoint, or where job factors do not fall within the mechanical limitations listed in Chapters VIII and IX, *is not a Pumpcrete job.*

Development of the low cost, portable Model 160 has broadened the field of practical possibilities until Pumpcrete methods very nearly embrace the entire range of concrete construction; excepting only the very small jobs and those few projects with unusually large volumes, over-size aggregates, excessive distances, etc.

Pumpcretes have successfully lowered costs on jobs ranging in size from 400 cubic yards up to several hundred thousand yards, and are standard placing equipment for hundreds of organizations on such diversified work as tunnels (all types), wide area and high buildings, industrial plants, power developments, dams, spillways, bridges and viaducts, grade separations, retaining walls, breakwaters, docks, piers, caissons, foundations, filtration and sewage treatment plants, reservoirs, grain elevators and others.

Why Pumpcrete Is the Lowest Cost Method of Placing Concrete on Most Jobs

Concrete is taken from the Mixer, transported to the forms and by means of various simple devices, distributed in such a manner that labor costs can be substantially lowered in the majority of cases. It will be noted the Pumpcrete is both *transporting* and *placing* equipment. As such, and because of its long range and extreme flexibility, there are certain other savings to be considered which do not usually appear in a breakdown of direct placing costs.

These savings are often difficult to set up in exact unit prices and they will, of course, vary widely with changing job conditions. Nevertheless, they can definitely be classified as tangible assets. As a matter of record, this feature has often been of more far-reaching importance to the smooth operation and financial health of some contracts than reductions in direct placement could possibly be.

The statement, "It is not a Pumpcrete job," is quite commonly expressed after but superficial examination of a job's potentialities. Advantages are not always self-evident and are quite apt to be overlooked. Close examination into conditions by one familiar with the "ins and outs" of general Pumpcrete procedure will generally uncover points of vital interest to the contractor. The decision then, as with the choice of all equipment, hangs simply on the problem of balancing possible savings against the initial investment.

Advantages other than savings in direct placement which may often be gained through use of the Pumpcrete:

1—*Simplicity of operation:*

Making for closer coordination between the integral units of any organization. Here is a procedure separate and distinct from other phases of the job. Concrete operations can be laid out and set up for normal progress with minimum interference to other equipment and activities. This one item has been acknowledged as the means by which overall job time, with the subsequent savings in overhead and the other trades, has been cut as high as 35% in some classes of work.

2—*Versatility:*

That is, a capacity for fitting in with the appurtenant equipment on hand without the need for additional expenditures. There is no "cut and dried" formula covering the manner in which a Pumpcrete can be used. Versatility is also extended to cover the wide range of choice and potential savings in the mixing plant setup, which is discussed in Chapter VII.

3—*Adaptability:*

Used here in the sense of adaptability to the various classifications of construction rather than to the changing panorama of job conditions.

The Pumpcrete is not one-job equipment. The contractor may be working on a building contract today and low on a sewage disposal plant tomorrow, or a bridge, or a tunnel. He still has the proper placing equipment in the Pumpcrete.

4—*Superior Concrete:*

The pipeline has the properties of an inverted steel trowel. Properly designed concrete with normal slumps is formed into a plastic cylinder and moves along through a film of grout without segregation or disturbance of the coarse aggregates. This insures control of the mix to the point of delivery which sometimes facilitates the problem of puddling by virtue of greater workability.

On tunnels and similar construction this question of "better concrete" is an established fact of no mean consequence to the builder. Consistently denser, higher test concrete reduces grouting costs and has other obvious advantages. The fact has been established by a number of extensive drilling and coring surveys that in such structures, Pumpcrete-placed-concrete is more uniform, tighter and several pounds heavier per cubic foot than concrete placed by other methods.

5—*Incidentals:*

Instances of incidental economies such as the cold weather savings detailed on pages 33 and 46; the safety factor realized in certain classes of work, etc., will be discovered in the typical job data outlined in Chapters II, III and IV.

By combining the foregoing and other characteristic advantages, many difficult concreting problems have been reduced to the routine of an ordinary setup. Jobs over bad ground such as loose sand, swamps, etc.; jobs not readily accessible by other means because of adjacent buildings, railways, thoroughfares, rivers, gorges, etc.; jobs that would prove costly and troublesome with other methods of placement have been handled smoothly and economically without fuss or feathers by the Pumpcrete. Pipelines can easily be carried over, under, through or around all ordinary obstructions by methods which seem only to be limited by the ingenuity and resourcefulness of the organization. There are instances recorded in which the estimated costs have been reduced anywhere from $1.00 to $3.00 per cubic yard on the unusual job.

UNUSUAL JOBS

Examples Where Contractors Have Taken Advantage of Pumpcrete Flexibility for Big Savings on Unusual Jobs

EXAMPLE NO. 1

Encasement of an old masonry bridge on the C. & O. Railroad Main line in Kentucky. Total concrete 3,000 cubic yards. Placed with model 160 and 7" pipeline. Contract called for minimum 9" shell reinforced concrete around piers, abutments and arches of the old structure and construction of new wing walls for the east abutment. The job site was accessible only from one side at the west end of the bridge where a spur siding was also available to extension for bringing in materials. It was necessary to maintain normal traffic on this double track railroad, which, being one of the nations's leading coal roads, was a very busy line.

The mixing plant could not have been placed closer than 200 feet to the bridge without seriously handicapping other operations, sacrificing valuable storage space, and increasing the cost of the siding.

Placing concrete directly into such forms was physically impossible by any method other than Pumpcrete, short of erecting tower chuting systems or trestle staging for runways on both sides of the bridge, or by spouting concrete from the deck. The latter method was impractical because

Figure 1.

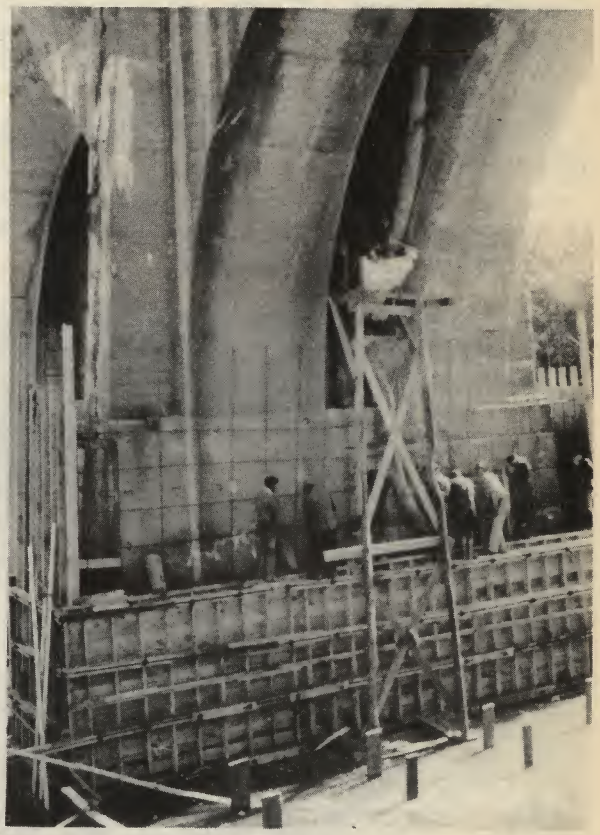


Figure 2.

of restrictions set by the railroad company for maintaining traffic and subsequent transporting difficulties, and the other two methods were out of the picture due to initial expense, rigging costs, cost of transportation, etc. Pumpcrete solved the problem; even with a complete charge-off of equipment against 3000 yards of concrete.

The contractor took full advantage of the job's possibilities; not only by installation of an economical plant set up out of the way of other operations, but in his method of distribution as well.

The plans called for 6" ballast drains to be drilled on approximately 20 ft. centers on the C/L of the bridge which in reality was two separate structures; one of pre-civil war masonry construction—the other concrete of ancient vintage.

By enlarging these drill holes to 8 or 9 inches and laying the pipeline between the railroad tracks, the contractor was enabled to pump into tremie hoppers, suspended below, for distribution in all but the top forms. Pipe handling and scaffolding costs were thereby cut to a minimum. On the longer drops, concrete was caught in a gated hopper and chuted short distances to either side, as shown in Figure 2.

The plant consisted of a 14-S Mixer set up under a 60-yard 2-compartment aggregate bin discharg-

ing directly into the Pumpcrete hopper. Aggregates were loaded from bottom dump cars by a bucket conveyor. Bag cement was handled from box cars on the same siding.

Proportions of mix by weight ..... 1 x 2.2 x 3.4
Coarse aggregate ..... ¾" gravel
Average slump ..... 4"
Pours ran from 40 to 120 cubic yards.
Maximum distance pumped 560 ft. horizontally plus a 15 ft. lift.

CREW REQUIRED FOR OPERATIONS:

Classification	*No. of Men*
Plant:	
Mixer operator (also handled batching)	1
Conveyor operator	1
Labor on bag cement (exclusive of storing)	3
Pumpcrete operator	1
Distribution:	
Labor at forms (average)	6
Foreman (handled all operations)	1
Total Crew	13

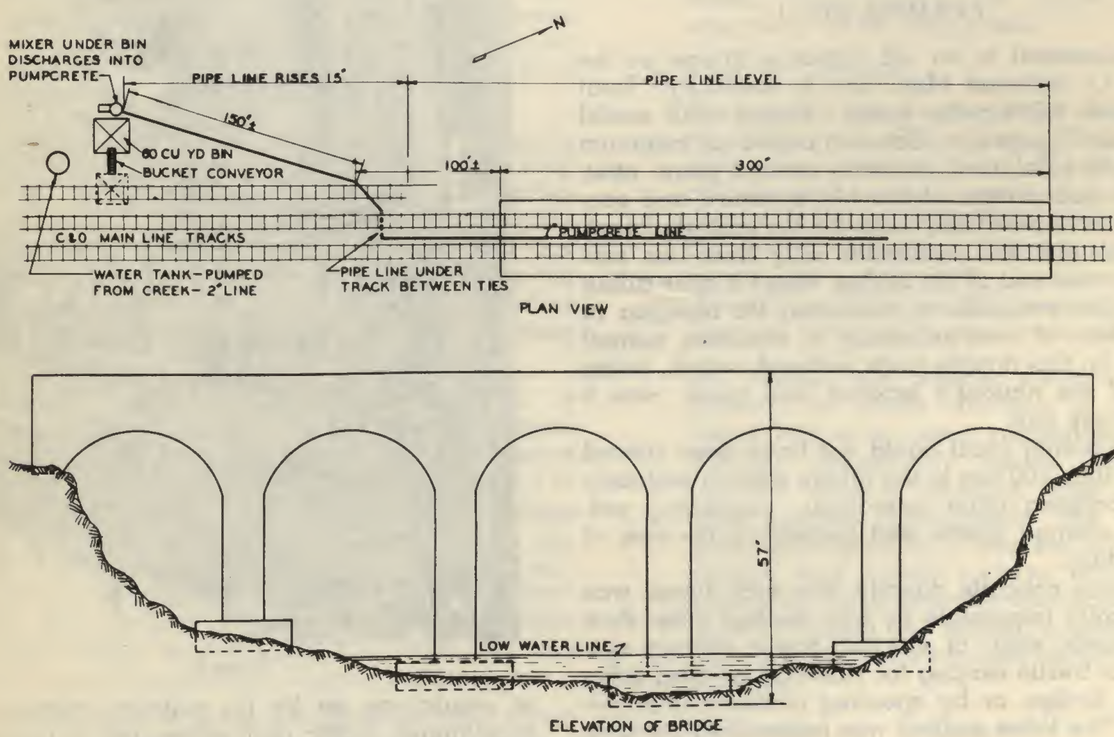


Figure 3.

EXAMPLE NO. 2

The L. & N. Railroad has utilized the Pumpcrete's long placing range to very good advantage in relining some of their main line tunnels which were originally braced with timber sets above the spring line.

Figure 4 shows a Model 180 plant setup outside a tunnel portal near Chavis, Kentucky. The bore is 1466 feet long on a 6 degree curve.

As it was necessary to maintain normal traffic during the course of repairs, the Pumpcrete was set up outside each portal in turn. Work started at the center of the tunnel some 750 feet distant and progressed back toward the pump in 12 foot sections. Concrete ran approximately 2.5 cubic yards per lineal foot of tunnel.

The 7" pipeline was laid against the wall to one side and introduced into the form in such a manner that it was not necessary to stop the machine when trains passed during concreting operations.

Figure 4.

EXAMPLE NO. 3

A public utility of Minnesota purchased a model 160 Pumpcrete as standard construction and *maintenance* equipment.

One of the first jobs that came up was that of building an addition to a power house, involving a total of 2,500 cubic yards of concrete. The job site was surrounded by a group of warehouses. This, and the fact that it was necessary to maintain normal traffic on an adjacent main line railroad and industrial spur tracks, made concrete placement quite a problem from the standpoint of accessibility for equipment and materials.

The Pumpcrete was set up some 500 feet away from actual pouring operations, well off to one side and out of the way. The pipeline was boxed out beneath the spur tracks, solving the problem of traffic maintenance and snaked in and out between the buildings, as shown in Figure 5.

To date the machine has been used on foundations for power house work and to repair dam spillways on their water control system. The Company states they have reduced placing costs by one-half on some of their work.

Figure 5.

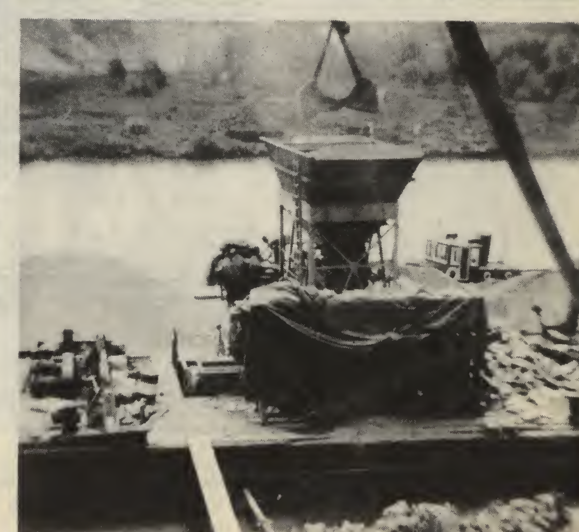


Figure 6.

EXAMPLE NO. 4

This Company placed approximately 15,000 cubic yards of concrete in the piers of two bridges three miles apart, across the Black River in Ohio. As the river was several hundred feet wide at these points and the piers for one bridge extended

back several hundred feet from the water's edge on either side, this was a setup calling for extreme mobility of equipment. The largest bridge was 1700 feet long with a maximum height of 70 feet above water level. The problem was solved very neatly with a floating plant. A model 180 with a 28-S Mixer was set up under a 120 ton aggregate bin on a barge as shown in Figure 6. Pipelines remained in place on shore and the plant was towed back and forth and up and down the river as required. The maximum distance pumped was approximately 600 feet horizontally with a 70 foot riser into the form.

Figure 7.

EXAMPLE NO. 5

Figure No. 8 illustrates a 7" pipeline supported for 460 feet across the Tiske River in Pennsylvania on a pontoon bridge constructed of old oil drums and the method employed in reaching the form directly from this improvised bridge.

The contractor was faced with the problem of placing approximately 425 yards of concrete in extensions on the end, and 4 foot caps on the top of several old masonry piers, two of which stood in several feet of water some distance off shore.

By ordinary placing methods, this job called for construction of a 450 foot trestle sturdy enough to support concrete transporting equipment and a crane, since it was not in a locality accessible to floating equipment. Quite an expense for a matter of 425 yards of concrete.

Construction of the pontoon bridge (which also sported a catwalk for use of the crew) and stringing pipe was accomplished in one day with a crew of 6 men at an overall cost of $66.00 for labor and materials. Oil drums were doubled, end to end, and spaced at 15 foot intervals by second hand 2" pipe (lashed with No. 9 wire) decked with scrap lumber and held in position by a second hand ⅝" cable stretched between piers. A shallow draught scow with outboard motor was used to transport forms and reinforcing.

Incidentally, this job was started and completely finished in a period of 2 weeks, working one 8-hour shift per day.

On several other occasions oil drum pontoons have proved satisfactory for supporting pipelines across rivers, marshes, etc., but this is about the longest span brought to our attention.

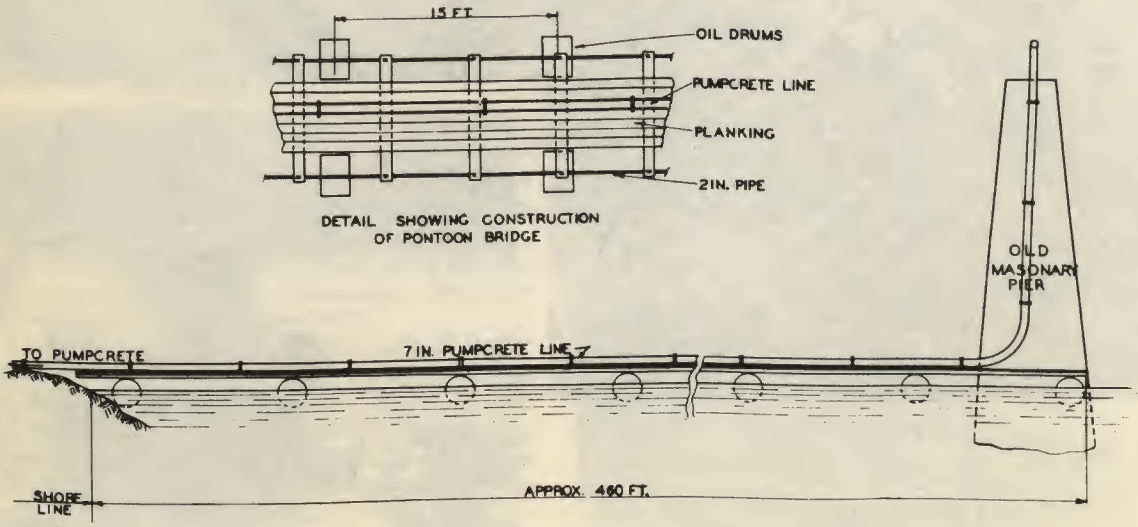


Figure 8.

CHAPTER III TYPICAL JOBS

Figure 9—Pipeline setup from Double Pumpcrete on Bronx Anchorage of Bronx-Whitestone Bridge, New York. Corbetta Construction Company, contractor. Some of this concrete was pumped to a height of 100 feet.

The jobs more or less briefly outlined in this chapter are representative of normal every day Pumpcrete methods. In some instances, thanks to the cooperation of "Pumpcrete minded" organizations and individuals, authentic man hour labor costs are included with details on procedure and pertinent job data. Some of the examples are rather incomplete in this respect but it is believed they will serve to help round out the picture.

That the listed information varies widely in nature and scope is due to the different accounting methods of individual organizations, as well as to the importance they attached individually to certain angles or phases of Pumpcrete methods applied to their specific problems. This fact has precluded the advisability of formulating a standard outline. By the same token and for other reasons, such as over-lapping between types of work, etc., the jobs have been grouped together or classified very loosely in what appears to be allied undertakings.

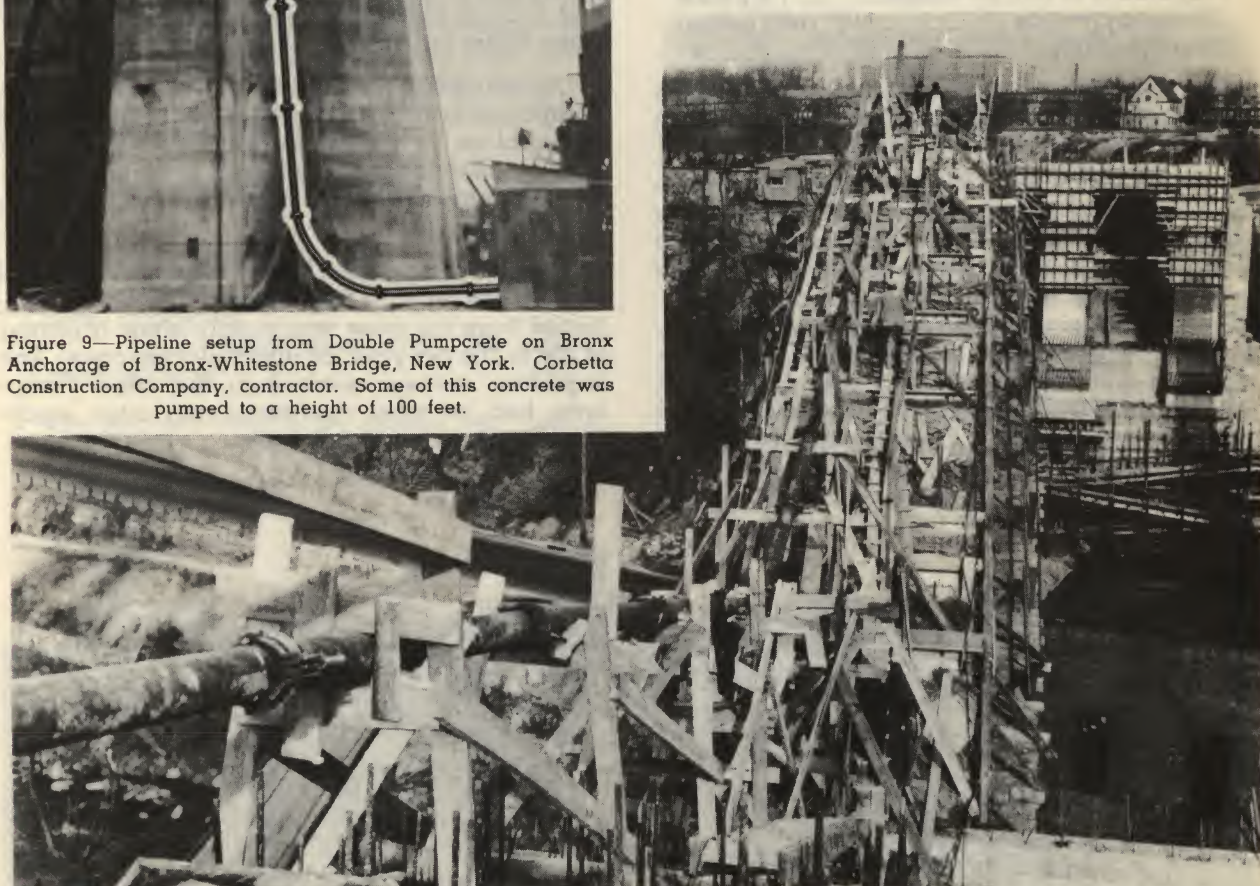


Figure No. 10—Model 180 Single Pipeline setup on 29th Street Bridge, Baltimore, Md. Potts and Callahan, Contractors. 5000 cubic yards placed in a concrete arch bridge without the difficulties usually accompanying a job of this nature. With the pipeline setup as shown, it was possible to keep the arch forms evenly loaded with very little loss of time in changing from one section to the other. *Note:* Alternate pipeline setups for this type of pour are shown in Figures 59 and 60 on Page 50.

Perhaps in no other general classification of construction has the pump and pipeline method of placement been applied with more readily apparent advantages.

Here is a field where myriad types of structural design combine with variable and constantly shifting conditions to create problems characteristic almost to each individual job. Because of this, bridge construction has inevitably been attracted to and by the Pumpcrete from the beginning of its development.

The model 160 is particularly effective, applied to unusually long jobs, or those where small pours in scattered locations place a premium on portability. Typical jobs No. 4 on page 12 and No. 7 on page 15 are very good cases in point.

Job No. 1

NECHES RIVER BRIDGE, PORT ARTHUR, TEXAS

General Contractor—Taylor-Fichter Company of Port Arthur, Texas.

Concrete Placed By—Beaumont Construction Company.

Model 160 Pumpcrete with 6" pipeline.
Proportions of mix by weight.......1 x 2 x 3.8
Coarse aggregate ....1½" river gravel
Average slump..........................4"

Mr. Mitchell, of the Beaumont Construction Company, who supervised the concrete work, tells the story in the following letter.

"On our estimate before buying Pumpcrete machine, we figured we could save at least $1.50 per cubic yard. By using Pumpcrete, there being 6500 cubic yards at $1.50, we saved $9,750.00. The Pumpcrete unit, in full, cost approximately $6,500.00, showing a net saving to us of $3,250.00. Besides, by having our Pumpcrete and concrete Mixer on a large barge, it was only a matter of minutes to be ready to pour concrete. We pumped concrete to a height of 85 feet and then up 5% grade on a bridge as much as 250 feet, same being as far as we wanted to go. At present we have our concrete Mixer and Pumpcrete unit up on top of the bridge, and are preparing to pump concrete 600 feet up bridge before making a move. We had no trouble with the machine. It has worked in all kinds of weather, and we have poured as high as 22 cubic yards of concrete per hour which is as fast as we can handle and finish it. We have cut out six men in our handling crew, and four of these men were expensive as they came under the $1.00 per hour rate."

"As you know, this is our first experience with Pumpcrete, and at first I might add, I was a little skeptical as to results, but since trying it out, I state in all sincerity, I believe it is the most modern way of handling concrete and the most economical way."

It will be noted that the contractor stated he made a saving of $1.50 per yard. The 6 men eliminated from his crew would only show a saving of 25c to 30c per yard for direct placing costs. The important savings resulted in the effect Pumpcrete had on other operations and other equipment requirements for the job.

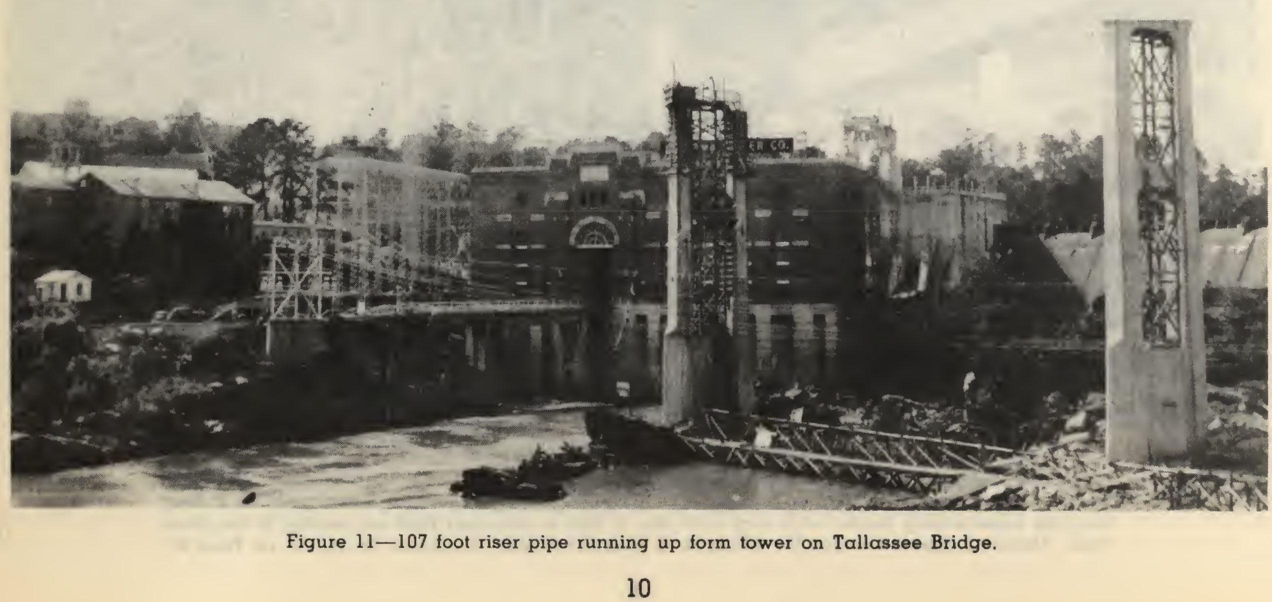


Figure 11—107 foot riser pipe running up form tower on Tallassee Bridge.

Job No. 2*

BRIDGE ACROSS TALAPOOSA RIVER, TALLASSEE, ALABAMA

The Hardaway Contracting Company of Columbus, Georgia, placed 3,000 cubic yards of concrete in the footings and piers of this bridge with the Model 160 Pumpcrete and 6" pipeline. After the steel was erected, an additional 2,500 cubic yards was pumped into the deck on another contract.

Mr. Ralph Bird, superintendent of construction, has supplied the following job data:

Concrete operations started March 6, 1939; piers were completed July 25th.**

Overall length of bridge—1739 feet. Highest point above Pumpcrete—107 feet.

Pumpcrete and Mixer were set up in two locations at an approximate labor cost of 8 hours for the Pump and Mixer operators; one mechanic, 6 laborers and one foreman. (Includes runways for trucks, piping, etc.)

Maximum distance pumped was 520 feet horizontally and 107 feet vertically with one 90 degree, two 45 degree, three 22½ degree and one 11¼ degree ell in the line. This is the equivalent of over 1400 feet of horizontal straight pipe. Average overall placing rate was 17 cubic yards per hour. A maximum pumping rate of 22 yards per hour was reached at times.

Average pour on piers was 40 cubic yards, placed in 15 foot lifts. Largest pour approximately 100 cubic yards in footing.

Proportions of mix by weight ---- 1 x 2.2 x 3.55
Fine aggregate ---------- washed river sand
Coarse aggregate ---------- washed river gravel, 1½" max.
Average slump ---------- 4½"

*This job was outlined in the February, 1940, issue of "CONCRETE."

**Deck concrete had not been started at the time this data was published.

Plant consisted of 14-S Mixer with wide skip set directly over the Pumpcrete hopper and charged by batch trucks hauling one-half mile from batcher bins located on a siding. Bins loaded by crane and bucket.

Distributing procedure was to run the pipe straight up the center of the form tower, high enough to deflect the stream of concrete to either side alternately.

Breakdown of total crew required for concrete operations at average rate of 17 cubic yards per hour:

Classification	*No. of Men*
Batcher Plant:	
Crane operator	1
Oiler and scale man	1
Labor	1
Truck drivers (average)	2
***Mixing & Pumping:**	
Mixer operator	1
Pumpcrete operator	1
Labor (dumping trucks and cement)	2
Foreman	1
Distribution:	
Carpenter (watching forms)	1
Labor (vibrating, puddling, etc.)	6
Foreman	1
Total Crew	18

**Note:* One mechanic was charged against plant during pouring operations.

Pipework was handled by the distributing crew. It was of minor consequence and not segregated as a separate cost item. This crew also cleaned and moved forms, etc.

Due to the nature of the work and small form volumes, the entire crew outlined above was used for other operations when not pouring concrete.

In passing, attention is called to the savings which can be readily visualized under the foregoing or similar circumstances. The Pumpcrete, by transporting to, and elevating concrete into the forms, eliminated the cumbersome and expensive operations of erecting, rigging and wheeling to the customary towers and hoists previously demanded by this type of work.

Figure 12—Pumpcrete and pipeline setup on Tallassee Bridge.

Job No. 3

HIGHWAY BRIDGE ACROSS THE RIO GRANDE RIVER AT BERNALILLO, NEW MEXICO

Contractor—Henry Thygesen, road contractor of Albuquerque, New Mexico.

Total volume of concrete—2500 cubic yards.

Model 160 Pumpcrete with 6" pipeline.

The bridge with 3 miles of road was completed in 23 weeks from February to July of 1938.

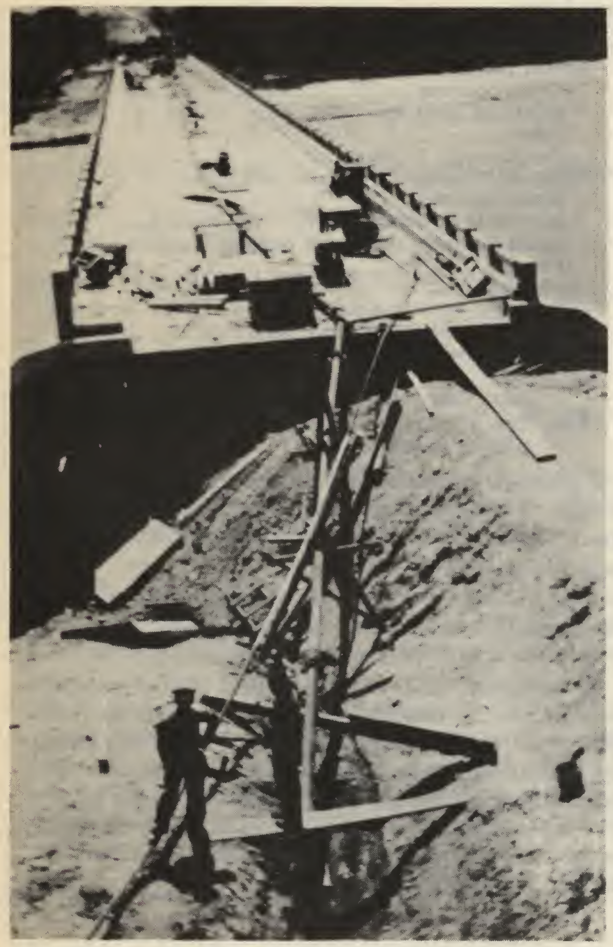


Figure 13—Pipeline setup on deck.

Mr. Henry Thygesen and Mr. C. W. Holford, superintendent of construction, have supplied the following data on this project:

Bridge was 955 ft. long with 19 spans on 50 ft. centers, a 24 ft. roadway and 3 ft. sidewalk on 6 steel stringers and 18 reinforced concrete piers.

All concrete was poured from one setup. In addition an 8 ft. x 3 ft. box culvert, 1155 lineal feet from the Pumpcrete, was poured from the same location.

The Pumpcrete was under a 14-S Mixer and batch hopper 75 feet from one end of the bridge and 10 feet below deck level. Piers and footings were poured in two lifts of about 35 cubic yards each.

The pipeline was laid directly on the ground for the first six piers and cut into the forms with 45 degree risers. After structural steel was placed on the first six spans the pipe was relaid on the deck and remained there for the balance of the job. Cost of handling pipeline was negligible.

For deck pours the pipeline was set up on wooden horses and concrete was distributed with a swivel chute, starting at the far end of a pour and working to the pump.

Distributing crew consisted of 3 men and a foreman who handled all pipe work, vibrating and chuting.

Proportions of mix by weight......1 x 2.3 x 3.7
Coarse aggregate............1½" river gravel
Average slump..............................4"

Quoting Mr. C. W. Holford:

"We find this piece of equipment is a time, labor and money saver on this kind of job. The setup can be made well back out of the way and eliminates the ever present hazard of floods, etc. As we had no pretentious or expensive river diversion protection it was a great relief in this respect. It also leaves all other equipment free that otherwise would be necessary to hoist or place the concrete."

Mr. Henry Thygesen says: "We were entirely satisfied with the performance of the Pumpcrete and convinced of its economy compared to any other method for this type of structure."

Job No. 4

LANCASTER STREET VIADUCT, FORT WORTH, TEXAS

The Fort Worth Sand and Gravel Co. supplied ready mix concrete and rented their Model 160 Pumpcrete to the contractor, Russ Mitchell, Incorporated, of Houston.

The viaduct, crossing the Trinity River bottom, is 2976 ft. long with 43 piers, the abutments and deck slab involving 10,000 cu. yds. of concrete. 1600 yards were placed in the footings direct from truck-mixers. The remainder, 4400 cu. yds. in the piers and 4000 yds. in the deck, was placed with the Pumpcrete.

Crossing an amusement park, railway tracks, two levees, etc., besides the river, this job placed a premium on portability. To match the mobility of the pneumatic tired model 160, the contractor built a portable truck ramp, constructed of light members and mounted on detachable truck wheels. The two were hooked behind a clean-up truck and snatched all over the job as required.

The job was very well organized and laid out to take advantage of the Pumpcrete's possibilities. The abutments, retaining walls and approaches at either end of the bridge were started simultaneously with the piers, which progressed from one end in sequence. Structural steel was placed in the same order, as fast as specifications permitted, followed immediately by deck forming.

The piers with the top beams ranged in volume from 45 to 90 cu. yds. and up to 45 ft. in height. They were placed at the rate of 4 piers per week. Concrete procedure for the piers and abutments was as follows: With tremies hanging from gate sections into two columns, and from the end of the line into the third, operations started at the far column; a 10 ft. lift was deposited, the adjoining gate section was opened for a 10 ft. lift and on to the next without stopping the pump, until time to make the next lift in the column first started. After the columns were up, pumping was halted 2 or 3 hours for settlement, then resumed for placing the beam. While pouring, a rate of 18 yds. per hour was maintained with the following crew:

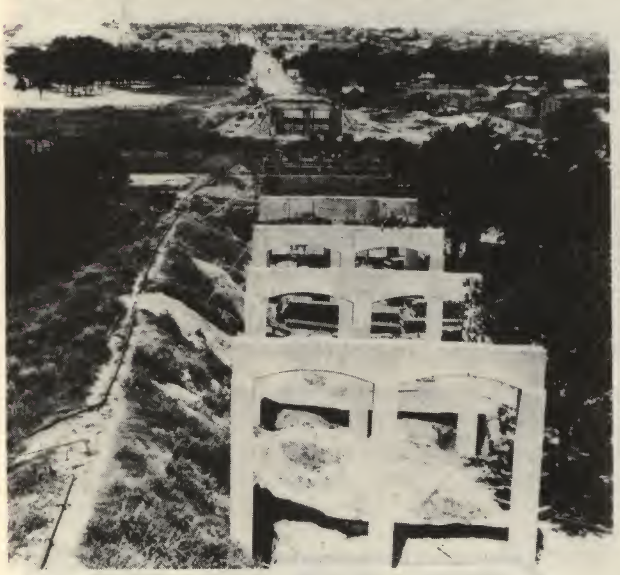


Figure 14.

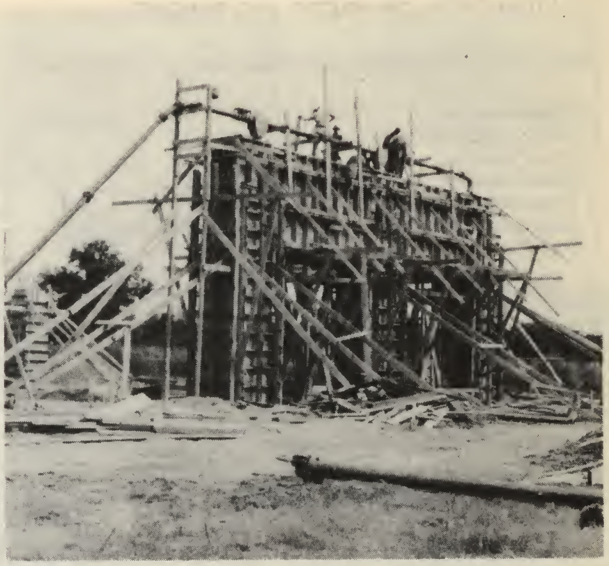


Figure 15.

Classification	*No. of Men*
Pumpcrete operator	1
*Vibrator men (one in each column)	3
Concrete labor (top and bottom handling gates, tremies, etc.)	3
Foreman	1
Total men in crew	8

*These 3 men returned to other duties as soon as the columns were poured. The foreman and 3 concrete laborers poured the beam and handled all pipe work between pours. A labor breakdown on slab pours is not available at the time of publication.

Job No. 5

On this overpass (a cold weather job) concrete was mixed in a 27-E Paver and pumped into place with a Model 160 and 6" pipeline at a labor cost of one man hour per cu. yd.

Pipe handling for the piers and abutments was .12 man hours per cu. yd. for erecting and dismantling and about half of that for the deck. 5 ft. gate sections were used on the counterforte columns which were poured in 10 ft. lifts. The pier columns were brought up in one lift and allowed to settle several hours before the top beams were placed.

55 ft. of the pipeline for one abutment and one pier crossed under a main line and railway yard switches as shown in Figure 16.

Figure 16—Pipe line passing under tracks and setup for abutment pour.

OPERATING CREW FOR MIXING AND PLACING:

Figure 18—Floating plant with pipe riser to bridge deck.

Classification:	*No. of Men*
Piers and Abutments:	
Mixer operator	1
Labor, dumping trucks and cement	2
Pumpcrete operator	1
Laborers at form (vibrating, moving tremies, etc.)	5
Foreman	1
Total Crew	10
Deck:	
Mixer operator	1
Labor, dumping trucks and cement	2
Pumpcrete operator	1
Labor distributing concrete (chutes, vibrator, etc.)	4
Strike-off men	2
Finisher	1
Foreman	1
Total Crew	12

Figure 17—Pipeline setup for deck pours.

Job No. 6

Figures No. 18 and 19 show an S. J. Groves & Sons Company setup on the Florida "Keys" Bridge.

24,000 cu. yds. of concrete were pumped into the deck of this bridge with a Model 200 Single Pumpcrete and 7" pipeline. An average of 180 cu. yds. was placed per 8 hour shift in alternate 20 ft. x 20 ft. sections for continuous pouring.

One of the outstanding features of the Pumpcrete operation was the ability to reach across a number of keys where water was too shallow to float the barges. At one point the pipeline was extended 700 ft. across shallow water. As shown in Figure 19, concrete was distributed with a counterweighted, swivel chute hung from the discharge pipe. The plant consisted of a 28-S Mixer mounted under the aggregate bins shown in Fig-

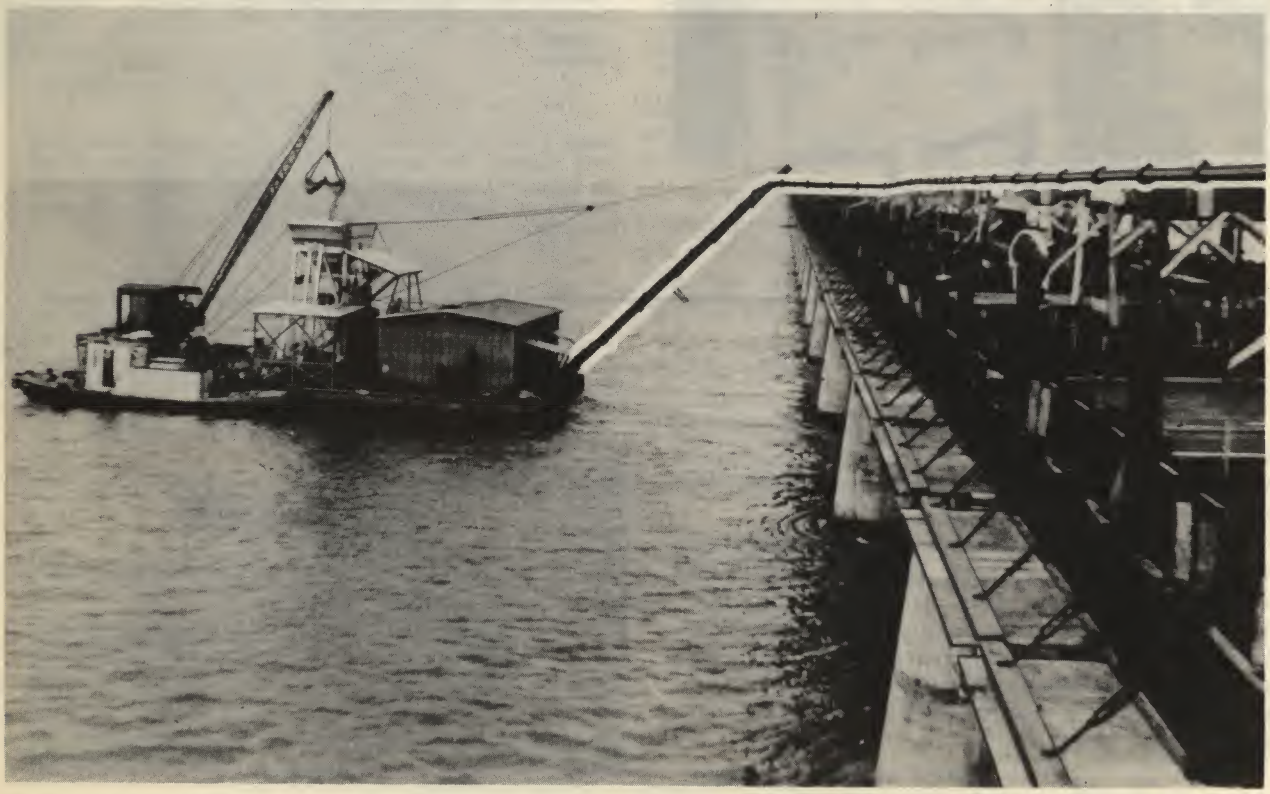


Figure 18—Floating plant with pipe riser to bridge deck.

Figure 19—Method of distribution into 20 ft. x 20 ft. slab sections with counter balanced swivel chute.

ure 18. The pipe line ran below the deck under the bag cement house and up the supporting boom at an angle of 45 degrees to a vertical height of 48 ft. The bins were loaded by a whirly crane from aggregate barges lashed to either side of the plant barge. The whole setup was moved along the bridge from section to section by means of a power winch.

Concrete crew required for mixing, placing and finishing—*does not include curing or transportation of material:*

Classification	*No. of Men*
Plant:	
Crane operator	1
Mixer operator (handled batcher)	1
Pumpcrete operator	1
Labor (handling bag cement, etc.)	4
Foreman	1
Distribution:	
Labor, chuting, vibrating, etc.	4
Strike-off man	2
Finisher	1
Foreman	1
Total Crew	16

Job No. 7

CONSTRUCTION OF 12 CULVERTS, ONE SMALL BRIDGE AND HEAD WALLS ALONG 4 MILES OF NEW HIGHWAY AT MT. MERIDIAN, INDIANA

Contractor—R. McCalman, Danville, Illinois.

Model 160 Pumpcrete with 6" pipeline.

Total volume of concrete — approximately 4000 cu. yds.

3,000 yds. or 75% of this total placed by the Pumpcrete; the remaining 1000 yds. was placed directly from Truck-Mixers.

The Pump was regularly moved from place to place to handle pours of 15 to 20 yds. The largest pour of 99 yds. on a single slab was made in 5¾ hours.

Average time for a one-mile move, laying and connecting 80 ft. of pipeline, was 1½ hours.

Mr. McCalman has stated, "You can quote me that the Pumpcrete at times saved up to a dollar per yd. and is one of the most efficient pieces of machinery I ever had on a job."

Figure 20—Typical setup on Mt. Meridan Highway Job.

Eureka Fireproofing Co., Inc.
Concrete Contractors
29-28 Hunter Street
Long Island City
New York

Telephone Ironsides 6 - 7390
7391

April 21, 1939

Mr. Frank Ginsberg
c/o Tractor & Equipment Corp.
355 Walton Ave.
Bronx, N.Y.

Dear Frank:-

As you suggested I have had the enclosed photographs made showing the #200 Rex Pumpcrete and pipe line setup on our job, the Brooklyn High School for Homemaking at Washington Ave. & President St.,Brooklyn, N.Y.

With this setup we poured 5000 yards of concrete in the floor and roof construction covering an area of 225,000 s.f. We started pouring February 24th and finished April 14th-7 weeks, which with the ordinary methods of buggies would take 11 to 12 weeks. The average speed of pour was over 40 yards per hour; the maximum 62. The area of the building is 35000 s.f.; the vertical rise was 80 ft. The difficult and ordinarily inaccessible places like the high sloping roofs were poured with ease as is indicated on one of the photographs. The significance of the time element is obvious as all succeeding trades were naturally affected.

I am very pleased to advise that there was not a single delay due to the operation of the Pumpcrete machine nor did we encounter any difficulty such as plugged lines or failure of parts.

If there is any further information kindly advise.

Best regards.

Very truly yours,

George Cohen

Leading building firms have accepted the Pumpcrete as permanent equipment and are going to town with their placing costs on schools, hospitals, barracks, prisons, housing projects, warehouses, office buildings and industrial plants of all kinds. One contractor bought a Model 160 less than two years ago and has now placed something over 25,000 yds. of concrete in several building jobs.

There is a Pumpcrete size to fit any type of mixing plant in common use in this field. It is not necessary to make changes in other equipment. Hoists and buggies are supplanted by the simpler more economical pipeline (releasing the former for other duties when desirable), and placing costs are cut accordingly.

Figure 21—Pipeline setup for a roof pour on the school building outlined in the letter on the opposite page.

Figure 22—Los Angeles Post Office Building in course of construction. Pumpcrete under central mixing plant in right foreground.

Job No. 1

FEDERAL POST OFFICE IN LOS ANGELES, CALIFORNIA

The Geo. A. Fuller Company pumped some 50,000 cu. yds. into this 17 story structure; the largest office building placed by the Pumpcrete to date. The building rises to a height of 215 ft. Floor slabs are 8" thick; walls run 8", 14", and 16"; beams 12", 16", and 48".

All the concrete in the first eleven floors (a height of 136 ft.) was placed by a Model 200 Double Pumpcrete with 7" pipeline. At this height 400 cu. yds. were pumped into floor slab in 7 hours, 20 minutes for an average of 54.5 cu. yds. per hour.

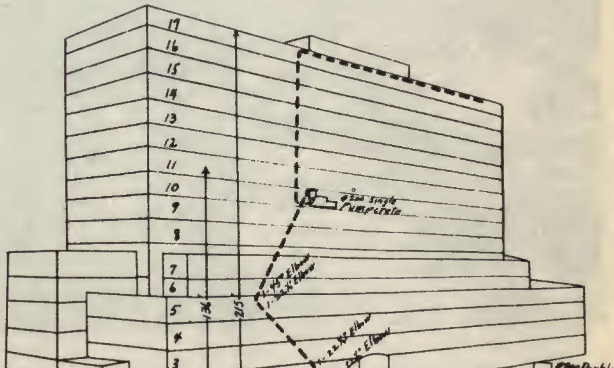


Figure 23—Approximate location of Pumpcrete and method of pipe line installations.

Figure 24—55 to 60 cubic yards per hour in 8" slab.

The pipe was set on an incline and passed through the floors. After the eleventh floor was finished, a 200 Single was placed on the tenth floor. One cylinder of the Double Pumpcrete on the ground pumped into this unit which re-pumped on up to the roof as shown in Figure 23. The other cylinder was used intermittently for scattered pours on the lower floors.

Pipe handling costs were minimized through careful planning. On the inclined elevations, 30 ft. sections were used whenever possible. 6 x 8 timbers were laid on the beams of the floor above for suspending the pipeline on 1" iron hooks for slab pours as shown in Figure 24.

The mix contained approximately 5½ bags of cement per cu. yd. to which some stone dust was added. The coarse aggregate was gravel and crushed gravel; it was all graded down from a ¾" maximum. The slump varied from 4" to 6".

This was the first time the Fuller Company had tried the Pumpcrete system in their building construction. At the present writing they are using a Model 200 Double for placing concrete on the Parcel Post Building in San Francisco. See Figure 25.

Figure 25—Geo. A. Fuller Company getting started on the San Francisco Parcel Post Building with a 200 double Pumpcrete and two 28-S Mixers in a central plant. The plant is located on a spur siding some distance away from the building, relieving congestion and simplifying material handling. The pipeline does not interfere with other operations. Note the spoil removal truck running over a buried section of the line.

Job No. 2

PULASKI HIGH SCHOOL, MILWAUKEE, WISCONSIN

Contractor—Kroening Engineering Corporation of Milwaukee.

Model 160 Pumpcrete with 6" Pipeline.

Area of building approximately 600 ft. x 325 ft. x 60 ft. high (5 stories).

Twelve thousand (12,000) cu. yds. were placed with the Pumpcrete in floor and roof slabs, walls and footings. An additional 3000 cu. yds. were placed directly into footing forms from Truck-Mixers. The Pumpcrete was used on footings when muddy ground made the forms inaccessible to Truck-Mixers. It handled the job from one setup and was housed in for the winter as shown in Figure 27.

Sixty per cent (60%) of the concrete was in slab pours. Floor slab was of inverted pan construction, 2½" thick, with beams averaging 5" in width and from 8" to 12" deep spaced on 24" centers.

Walls ranged in thickness from 8" to 15", averaged about 10" for the building. Pipeline was set up on saw horses beside the top of the wall. A roller extension spout was used for distribution. Starting at the far end of the line, the spout reached 10 ft. each way, two 10 ft. pipe sections were removed as the lift came up, the pipes emptied into the form and the process repeated until the near end of the wall was reached. Often parallel walls were near enough together for the pipe to be set up midway between; then both would be filled by alternate spouting from one side to the other.

Wearing parts on this job were $.02 per cu. yd. for the 12,000 yds. which included re-lining the machine after completion of the contract.

The Kroening Corporation have also used their Pumpcrete to place the 4200 cu. yds. of concrete in a sewage disposal plant for the City of Kenosha, Wisconsin.

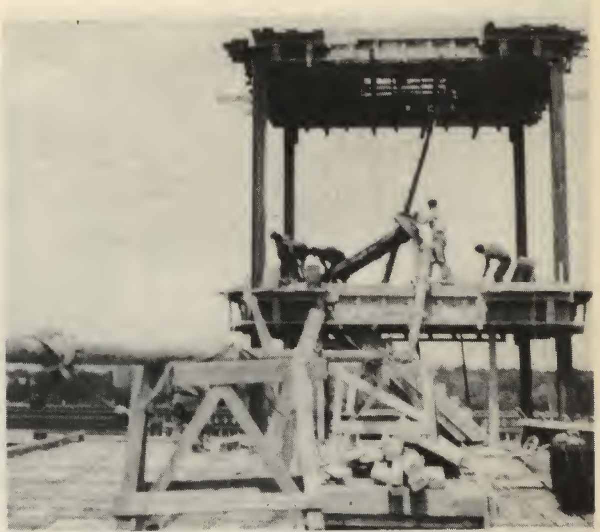


Figure 26—Pouring chimney slab. 95 ft. of vertical pipe plus a 300 ft. horizontal line.

Figure 27—Pumpcrete housed in and decked over for Moto-Mixer delivery of concrete.

Figures 28 and 29—State Office Building, Madison, Wisconsin. J. H. Findorff & Son, Contractor. A model 180 single with 7" pipe pumped all the concrete into the floors, beams and wall sections of this building, reaching far beyond its rated capacity. By setting the pump and mixing plant in the basement, the contractor was able to capitalize on a gravity feed into the bins for truck hauled aggregate.

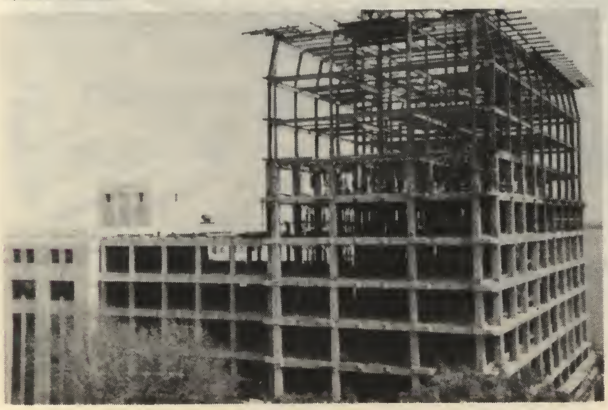
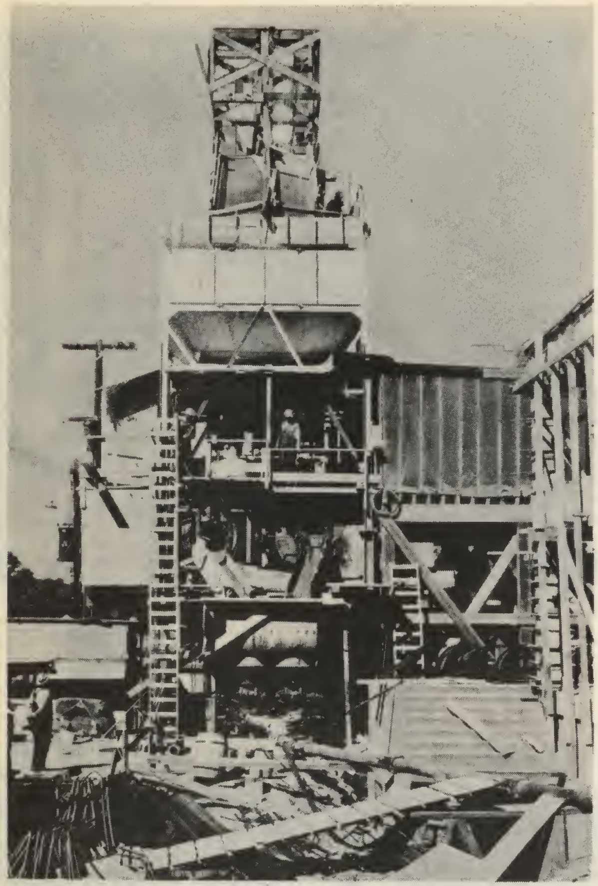


Figure 28.

Figure 29.

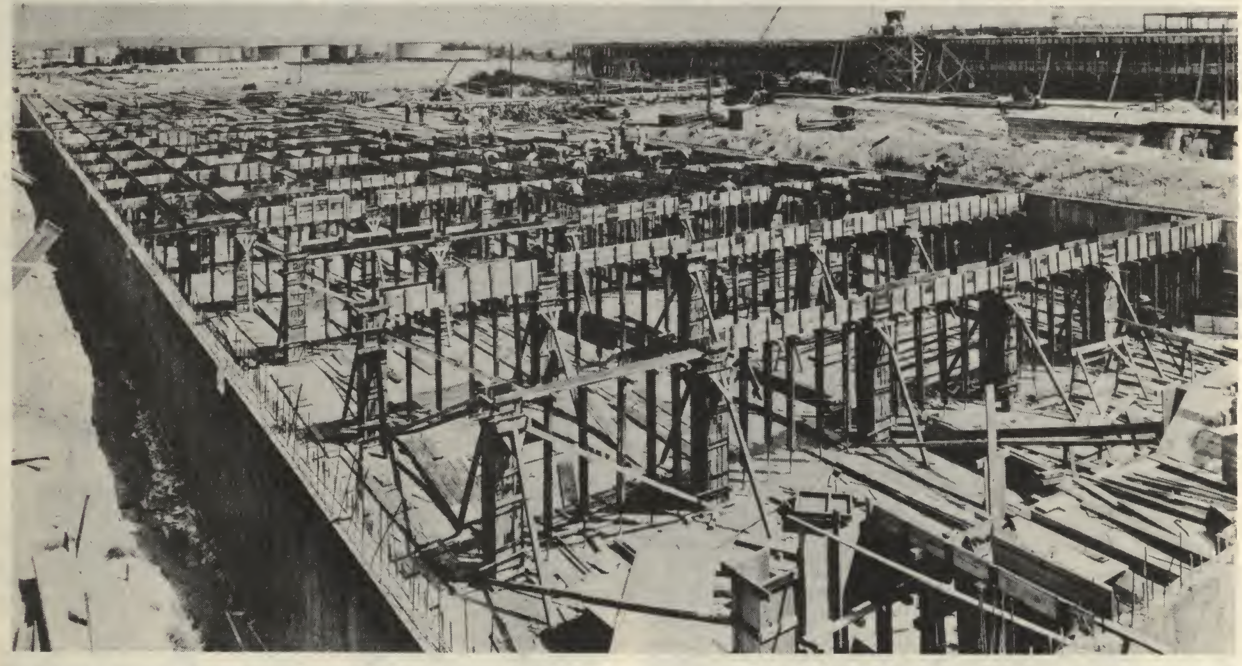


FROM TWO MIXERS, concrete flows into hopper of double-chambered pump installed on ground at base of plant. Cement house is at right, on level with batching platform.

Central Plant Pumps Concrete TO FOUR BUILDINGS

PUMPING THROUGH PIPE LINES up to 900 ft. long, a double-chambered concrete pump stationed under a central mixing plant delivered 19,182 cu.yd. of concrete to four produce buildings erected under a $1,350,000 contract by the S. Patti Construction Co., Kansas City, Mo., as part of a $4,000,000 food market and terminal recently opened by Kansas City, Kan. Two electrically powered mixers supplied concrete in 20-cu.ft. batches to the hopper of the pump. Distributing concrete from the discharge end of the pipe line, the placing crew was able to deposit in forms as much as 500 cu.yd. in 8 hr. on slab pours. In slab work, depending upon the area available for concreting, the contractor obtained daily yardages of 420 to 512 cu.yd. Progress on wall construction, although slower, was quite good, as indicated by placement of 267 yd. in one 12-in. wall 11 ft. high in slightly more than 6 hr. — an average of better than 40 yd. an hour.

A complete set of prefabricated forms for one entire produce building — basement walls, first floor slab, frame and roof — made it possible for carpenters to keep ahead of the concrete gang and erect sufficient formwork to take the



SERVING FOR FOURTH TIME in construction of final produce building, column and beam forms give evidence of good condition, with location markings on column panels still plainly discernible.

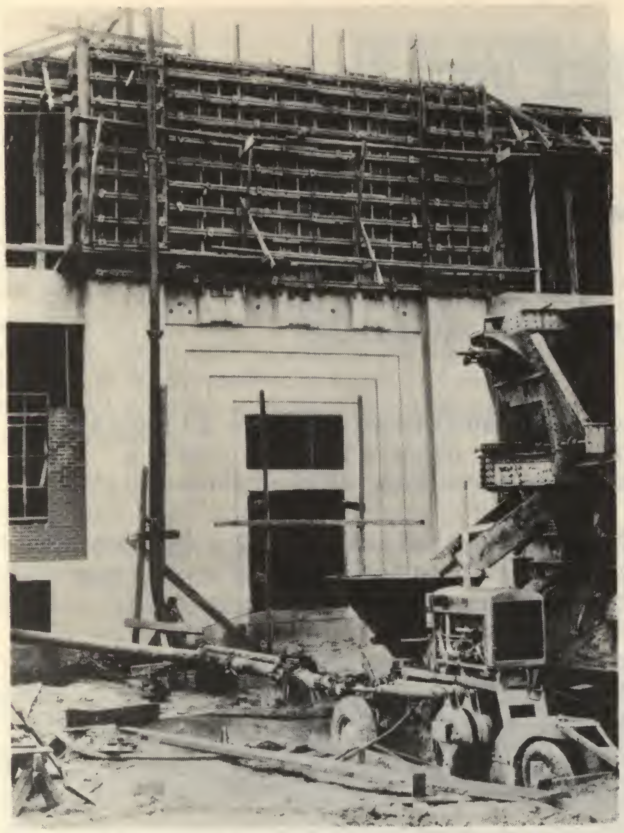


Figure 30—Model 160 setup under paver. The John G. Yerington Company placed 8000 cubic yards in this 4-story cold storage warehouse for the House of David colony, Benton Harbor, Michigan. With two pipelines in place, one to the top of the forms and one to the basement, the contractor alternated his pumping and maintained an almost steady placement program; pouring up to 200 cubic yards daily.

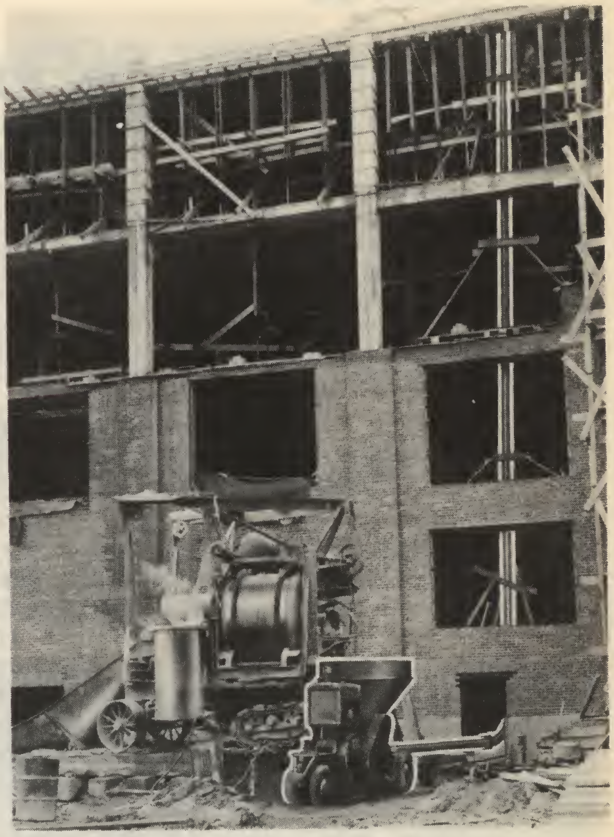


Figure 31—160 setup on 5-story warehouse for the Kimberly Clark Corporation in Neenah, Wisconsin. The 5000 yards of concrete in this building (approximately 65 ft. high and 150 ft. long) was placed almost continuously with a minimum of interference to other operations, by the Koepke Construction Company of Appleton, Wisconsin.

JONES ISLAND FIELD OFFICE
PHONE MARQUETTE 6823

G. R. FEHR, INC.
ENGINEERS AND CONTRACTORS
2755 SOUTH 34TH STREET

PUBLIC WORKS
SEWAGE DISPOSAL
WATER SUPPLY

TUNNELS
CAISSONS
FOUNDATIONS

MILWAUKEE, WIS., January 8, 1935.

Chain Belt Company,
Milwaukee, Wis.

Attn: Mr. M. Mills.

Gentlemen,-

In the construction of the addition to the Milwaukee Sewage Disposal Plant which we recently completed we used a double Pumpcrete machine and two one-yard Rex Mixers.

This project consisted of the placing of about 52,000 cubic yards of concrete. Of this amount 22,000 yards was in a bottom slab two feet thick resting on piles and heavily reinforced. This entire slab was placed in twenty working days of twenty-four hours, making our average progress 1100 yards per day. Our maximum run was 1236 yards in a day. During this period we had two continuous pours of over eighty hours and several of forty-eight hours or more. Our greatest length of pipe line was 990 feet; the average about 600 feet.

The remaining 30,000 yards of concrete was poured in walls, slabs, channels, etc., which involved over 800,000 square feet of formwork. These pours necessarily were of shorter duration but we feel that the pumpcrete machine proved more efficient even in these small pours than any other device we could have used. The aeration tank walls were built in 400 yard pours and it averaged eleven hours to pour them.

The pumpcrete machine occupies only a small amount of space and the pipe line is very flexible. It interferes a minimum amount with the operations of form moving and with the use of derricks, cranes and other equipment. The pipe line with its quick-acting couplings is far easier to move than a lot of heavy and cumbersome machines. The use of this placing method left our job in a condition which required but little expense for cleaning up; and the loss of concrete was negligible.

We wish to thank your engineers for the cooperation shown in working out the details of devices used on this work for transporting the concrete from the pipe to the forms and for the pipe line valves used in pouring the walls.

Were we to do this job over again we would use your Pumpcrete and your pipe. We consider it ideal for a job of this kind.

Yours truly,

G. R. Fehr,
by Grant M. Hinkamp.

FILTRATION and SEWAGE TREATMENT PLANTS • PUMPING STATIONS • RESERVOIRS, Etc.

Here is still another branch of construction where striking advantages in Pumpcrete methods are immediately apparent. Pipeline transportation simplifies the problem of placing concrete in comparatively wide areas involving a scattered distribution of pours, in localities often difficult of access. Tanks and structures are usually so arranged it is impossible to carry out concrete operations by other methods without interference to other activities.

A study of cost estimate No. 3 in Chapter VI will show why it will often be economical to install a Pumpcrete plant on large jobs where a gantry cableway is available for handling forms, reinforcing and concrete. In other words, where large quantities are involved, the difference in direct placing costs and mixing plant savings will not only more than pay for the pumping equipment but will expedite progress by freeing the high line for other duties during concrete operations. On contracts where a tight schedule is enforced, this can be a very important consideration.

The pump has more than "paid its way" on dozens of such projects all over the country ranging from the baby plants of 1500 yards or less, up to the Milwaukee and Detroit Sewage Treatment Works of 50 odd thousand yards each. At the time of publication, Michael Pontarelli & Sons have set up to place all of the 190,000 cu. yds. in the sub-structure of Chicago's 79th Street Filtration Plant with Pumpcrete.

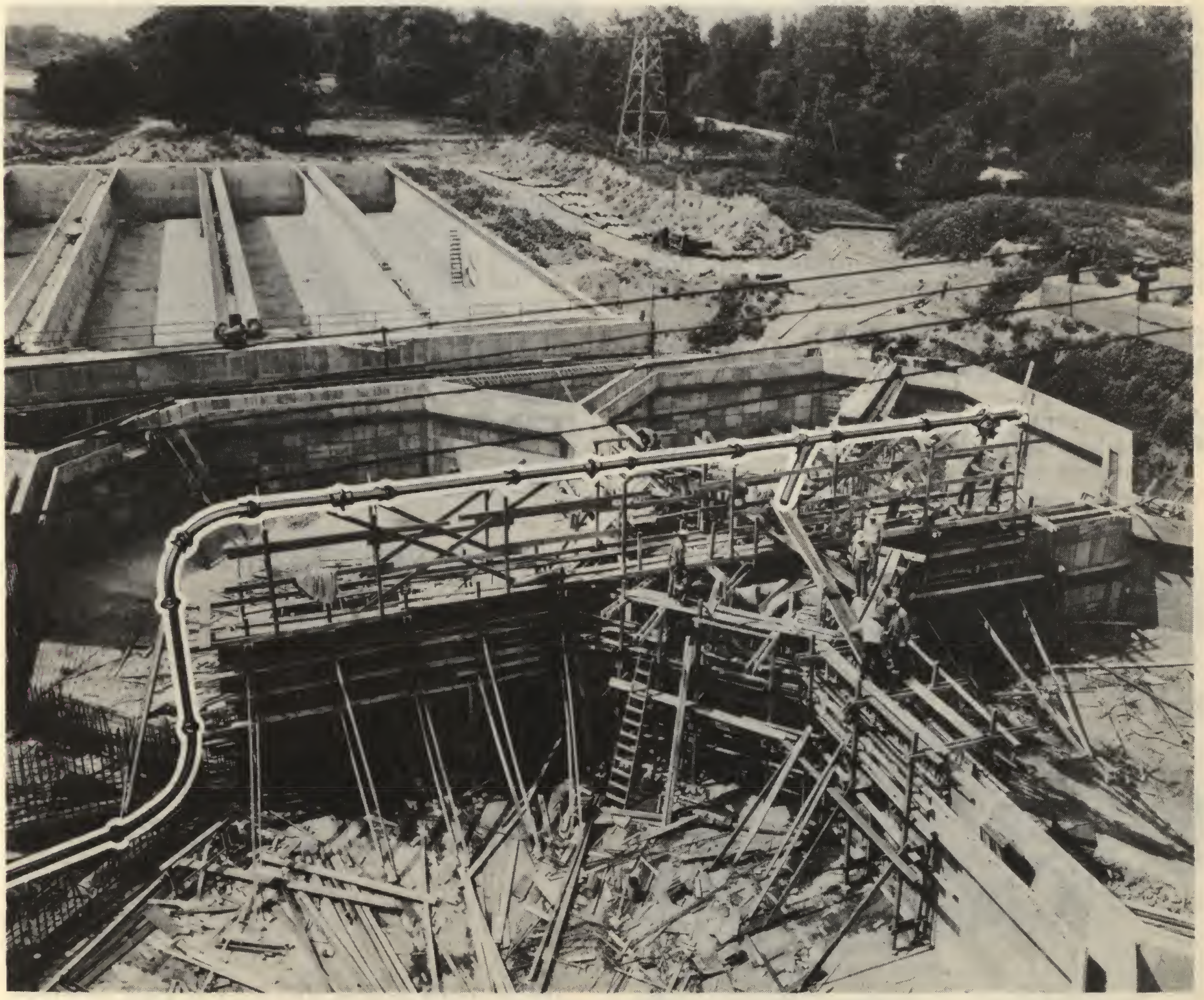


Figure 32—Indianapolis Sewage Treatment Plant. 12,000 cu. yds. pumped by Charles R. Wermuth & Sons of Fort Wayne, Ind. Model 180 Pumpcrete with 7" pipeline.

Job No. 1

SEWAGE TREATMENT PLANT, TWO RIVERS, WISCONSIN

Contractor—Ferd J. Robers, Burlington, Wisconsin.
Total concrete—1800 cu. yds.
Model—160 Pumpcrete with 6" pipeline.
Maximum distance pumped—200 ft. with 20 ft. riser.
Overall placing rate, job average, 16 cu. yds. per hour. This rate set by mixing time on 14-S Mixer.

Proportions of mix by weight	1 x 2.7 x 3.0
Pozzolith for tank walls	12 lbs.
Coarse aggregate	1½" gravel
Average slump	3"

Plant consisted of a 14-S Building Mixer with aggregates wheeled from stock piles.

Distributing and finishing crew required for various types of pours and the overall placing rate is shown in the following breakdown:

Footings and Slabs

Approximately 800 cu. yds.
Slabs 16 to 20 ft. wide, 60 to 71 ft. long, 12" thick.
Men required — 4 puddlers (handle pipe, chute and vibrator), 2 finishers, 1 foreman.
Average overall placing rate—17 yds. per hour.
Start placing at far end of pipe and work to pump; pipe supported on shoulder high horses.

Circular Walls

Approximately 250 cu. yds.—average 12" thick.
Pump station—33 ft. inside diameter (21 ft. below datum).
Digestors—40 ft. inside diameter.
Men required—2 chute men, 2 vibrator men, 1 foreman.
Average overall placing rate—17 yds. per hour.
Pipeline was hung from "A" frame and concrete distributed by means of a swivel chute discharging into auxiliary chutes. This was a continuous pumping operation.

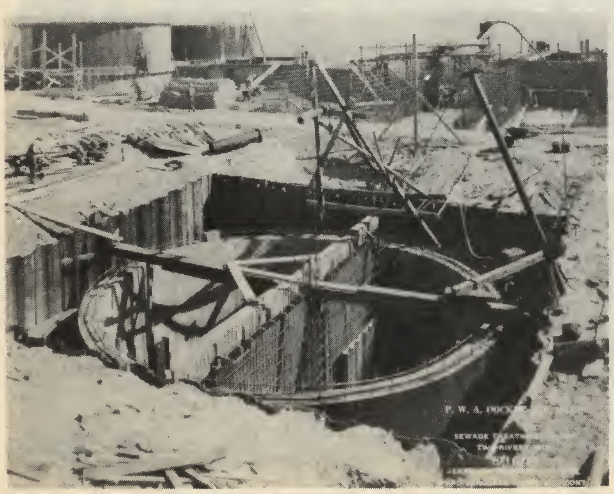


Figure 33—General view showing pipeline setup.

Figure 34—"A" frame setup for distribution into first lift of digestor tanks.

Straight Walls

Approximately 750 cu. yds.
Aeration—4 tanks 20' x 71' x 12'-6" high (10" thick; Y wall type).
Clarifiers—4 tanks 16' x 60' x 12'-6" high (10" thick; Y wall type).
Miscellaneous control houses.
Men required—2 buggy men, 1 hopper man, 2 vibrator men, 1 finisher, 1 foreman.
Average overall placing rate—15 cu. yds. per hour.
Because of monolithic structure and specified 12" to 18" lifts, it was economical to buggy the areation and clarifier tank walls from a central floor hopper.*

**Note:* Where floor hoppers and buggies are the most economical setup for distribution, as pointed out in Chapter IV, pipeline transportation permits more advantageous locations for the hopper and continuous pumping. No delays will result from partial discharging of the mixer as is the case with some buggy jobs.

Average Labor Force and Man-Hour Cost Per Cu. Yd.

Classification	*No. Men Per Hour*
Mixer operator / Pumpcrete operator	1
Puddlers (pipe work and vibrating)	4
Hopper man (straight walls only)	1
Buggy man (2 on straight walls)	1
Finishers (1 on walls, 2 on slabs)	1
Foreman	1
Average total man-hours per hour of operation for mixing, transporting, placing and finishing	9

An accurate record was kept of pipe handling costs for moving and rigging between pours. Part of the regular concrete gang handled this

work at an overall cost of .18 man-hours per cu. yd. With more concrete and larger pours, this figure would have been lowered proportionately.

An example of the organization's efficiency is the "A" frame rigging in Figure 34. This frame was constructed and set up with the pipe in place by 4 men in 3 hours. On the next lift, the same "A" frame was extended 15 ft. and set up outside the tank at about the same cost.

Remarks

Mr. R. D. Andreen, superintendent in charge of construction, has stated the big advantages of Pumpcrete on this job, were in placing all concrete from one setup (no loss in material from changing stock piles, rehandling of cement and moving the Mixer) and the fact that other operations were enabled to carry on with no interference from the concrete.

Job No. 2

CITY OF DULUTH RESERVOIR*

Contractor—A. A. Bodin & Son of Duluth.

Model 160 Pumpcrete with 6" pipeline.

Maximum distance pumped was 700 ft.

5,800 cu. yds. of concrete were placed with Pumpcrete on this contract in two months from October to December of 1938 at an approximate cost of 1.03 man-hours per cu. yd. for pumping, placing and finishing. All pipe work handled by regular crew.

Overall average placing rate, including washout and delays—16 cu. yds. per hour.

Plant consisted of a paver charged by one shuttle truck from a 20 yd. road bin set at stock pile some 50 ft. distant.

Proportions of mix by weight _____ 1 x 2.1 x 3.4
Coarse aggregate _____ 2" gravel
Average slump _____ 2" to 4"

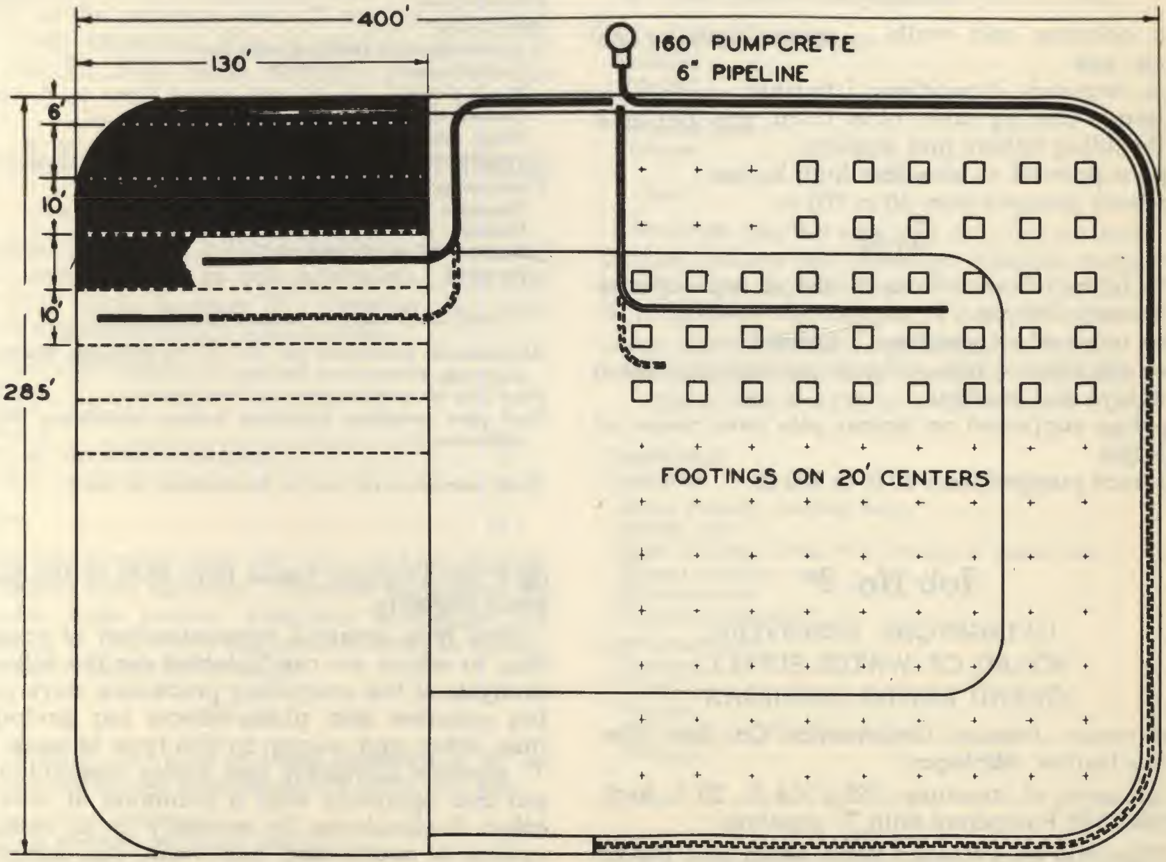


Figure 35—Location of plant in relation to Reservoir and pipeline layout.

*This job was outlined in the March, 1940, issue of "CONCRETE."

Figure 36—Placing concrete at the rate of 14-15 yds. per hour on small footings with Model 160 on the Duluth Reservoir.

Distributing and finishing crew required for various types of pours and the overall hourly placing rate is shown in the following breakdown:

Footings

For columns and walls — approximately 1030 cu. yds.
Men required—4 puddlers, 1 finisher.
Average placing rate—14 to 15 cu. yds. per hour including delays and washout.
Pipe supported on shoulder high horses.
Distance pumped from 50 to 700 ft.

Walls

6 ft. high, 18" at bottom to 15" at top—approximately 380 yds.
Men required—4 puddlers, 1 finisher.
Average placing rate—17 yds. per hour, including delays and washout.
Pipeline supported on timber sets over center of forms.
Distance pumped from 50 ft. to 700 ft.

Columns

2 ft. diameter from 12 ft. to 32 ft. high—approximately 816 yds.

Men required—4 puddlers.

Average placing rate—15 yds. per hour, including delays.

Pipeline supported on timber horses set on floor forms.

Distance pumped—from 50 to 450 ft.

Floor Slab

8" to 12" slab—approximately 3600 cu. yds.

Men required—4 puddlers, 2 strikeoff men, 1 finisher.

Average placing rate—17 cu. yds. per hour, including delays.

Pipe supported on low horses, pouring 6 ft. to 10 ft. strips.

Distance pumped—from 50 to 450 ft.

Average Labor Force and Man-Hour Cost Per Cu. Yd. at Job Average of 16 Cu. Yds. Per Hour

Classification	*No. Men Per Hour*
Plant Crew:	
Crane operator (loading road bin)	1
Batcher man	1
Truck driver	1
Cement dumper	2
Mixer operator	1
Pumpcrete operator	1
Distribution:	
Concrete labor at end of pipe (puddlers)	4
Finisher	1
Finisher helper (strikeoff)	1
Foreman	1
Total man-hours per hour of operation	14
Approximate man-hours per cu. yd. for batching, mixing, pumping, placing and finishing	.88
Plus 10% for maintenance and incidentals	.09
Plus pipe handling, including horses, scaffolding, etc., estimated at	.06
Total man-hours per cu. yd. for concrete in place	1.03

Job No. 3*

LIVINGSTONE RESERVOIR,
BOARD OF WATER SUPPLY,
GRAND RAPIDS, MICHIGAN

Contractor—Pearson Construction Co., Inc., Benton Harbor, Michigan.

Dimensions of structure—322 x 354 ft., 23 ft. high.
Model 180 Pumpcrete with 7" pipeline.

This was an excellent plant setup and the organization's efficiency is attested by their speed in completing a job this size under the handicap of a Michigan fall and winter. A pouring rate of almost 22 cubic yards per hour was established as a job average; better than 75% of the plant's peak capacity.

Emil Rutz, general superintendent of construction, to whom we are indebted for the following analysis of the concreting procedure, says pumping concrete into place effects big savings in time, labor and money on this type of work. The 7" pipeline is quickly and easily assembled and put into operation with a minimum of time and effort. It eliminates the necessity for an extensive system of scaffolding and hoists and speeds up all the other operations. Most of the pouring was done at night (although a 24 hour concrete schedule was necessary at times); a circumstance that was greatly facilitated by pipeline distribution.

*"Construction Methods" job story.

Plant Setup

A 60 ton, 2-compartment bin and weigh batcher discharged into the Paver skip which, in turn, discharged directly into the Pumpcrete hopper by means of a short chute. The plant was centrally located near one end of the job. The maximum distance pumped through 7" pipeline was about 500 lin. ft. with a 28 ft. lift. Average distance was around 300 feet. Bag cement was trucked from railroad cars to job as required.

Concrete Data

Total volume of concrete—11,800 cu. yds.
Maximum placing rate—about 28 cu. yds. per hr.
Job average 21 to 22 cu. yds. per hour.
120 to 250 yds. placed in the average pour.

Proportions of mix by weight — 1 x 2.57 x 3.25
Coarse aggregate — 1¼" gravel
6 lbs. calcium chloride powder (Dowflake) was employed as an admix to facilitate form removal.
Mixing time — 1½ minutes.
Water cement ratio — 5½ gal.
Average slump — 4½"
28 day cylinders ran from 3500 lbs. to 5400 lbs.

This was an excellent mix from the standpoint of plasticity and pumpability and the rated capacity of the pumping unit (27 cu. yd. per hour) was often exceeded. Use of calcium chloride in the mix for high early strength permitted the stripping of wall forms two hours after pouring.

Breakdown of Pouring Operations

Bottom Slab

Bottom slab and column footings (at ground level) were poured in one operation. The slab was 8½" thick, footings 30"; together they contained approximately 5,450 cu. yds.

Men Required for Distribution:

Puddlers	4
Vibrator	1
Finishers	2
Strike-off men (finisher's helpers)	2
Foreman	1
Total	10

Average placing rate—22 yds. per hour, including delays and cleanup. Pipeline supported on shoulder high horses. Concrete distributed by means of a 10 ft. swivel spout. Poured in continuous strips about 20 ft. wide.

Walls

23 ft. high, 30" wide at base, battered to 16" at the top; contained approximately 2800 cu. yds.

Men Required for Distribution:

Puddlers handling gates and spouts	4
Vibrators (internal)	2
Vibrators (external)	2
Finisher	1
Foreman	1
Total	10

Average placing rate—22 cu. yds. per hour, including delays and cleanup. Pipeline was carried on 2 x 6 scabbing about 4 ft. above the forms. Concrete was distributed from gate valves in the pipeline every 20 ft. and brought up in 2 ft. lifts. Wall forms were made up in 12 ft. x 23 ft. panels and handled with a crane. Sections formed and poured ran from 70 to 150 ft. long.

Columns for Roof Slab

18" in diameter, 23 ft. high and spaced on 20 ft. centers both ways; contained approximately 550 cu. yds.

Men Required for Distribution:

Buggy men	3
Hopper man	1
Vibrator	1
Foreman	1
Total	6

Average placing rate—18 yds. per hour, including delays. Pipeline discharged into centrally located hopper spotted after form for roof slab was in place. Concrete distributed to columns by buggies.

Roof Slab

8" thick; approximately 3000 yds. in roof.

Men Required for Distribution:

Puddlers	4
Vibrator	1
Finishers	2
Strike-off men	2
Foreman	1
Total	10

Average placing rate—21 cu. yds. per hour, including delays and cleanup. Pipeline supported on shoulder high horses. Concrete distributed in 20 ft. strips by means of a 10 ft. swivel spout.

LABOR FORCE REQUIRED FOR BATCHING, MIXING, PUMPING, DISTRIBUTING AND FINISHING CONCRETE AT THE AVERAGE RATE OF 22 CU. YDS. PER HOUR

Classification	*No. of Men Per Hour*
Plant Crew:	
Crane operator (loading bins)	1
Batcher man	1
Labor handling chute from batcher to paver skip	1
Cement handlers	2
Mixer operator	1
Pumpcrete operator	1
Distributing Crew:	
Puddlers	4
Vibrator	1
Finisher	2
Strike-off man (finisher's helper)	1
Foreman	1
Total	16

Remarks

Pipe moving between pours was handled by the puddlers who served as a utility labor crew when not pouring; it was not segregated as a separate cost item but was of minor consequence to the general setup.

Figure 37—Placing bottom slab and column footings in one operation, Livingstone Reservoir. Deck forming and completed wall section in background.

Job No. 4

PUMPING STATION

Model 200 double Pumpcrete with 7" pipeline.

Maximum distance pumped was 650 ft. with 25 ft. riser.

35,000 cu. yds. were placed at a cost of .95 man-hours per cu. yd. for batching, mixing, hauling, placing, finishing and pipe handling labor.

Concrete was placed at the rate of from 25 to 65 cu. yds. per hour, depending on the type of pour. The average was lowered considerably by the use of forms that could not be filled too rapidly. The pump was purposely operated at one-half normal capacity or less, on most wall pours.

Mix proportions were 1 x 2.9 x 3.7 by weight with 2" gravel for coarse aggregate. Average slump was about 4".

This was an excellent mix from the standpoint of plasticity, workability, etc., and was pumped all winter through as much as 600 ft. of unprotected pipeline without difficulty. Wearing parts were less than $.05 per yd. for the 35,000 cu. yds. placed.

Concrete was wet-batched a distance of one mile in flat bottom dump trucks from a plant in the material yard. This method of mixing, which provided substantial savings in material costs and plant operation was made possible, or, at least facilitated by the reconditioning efficiency of the pugmill Remixer. No pumping difficulty was occasioned by the circumstance.

The plant (operated by 5 men) consisted of two 28-S Mixers, 30 yd. aggregate bin with weigh-batchers, 700 barrel cement silo, 5" cement blower and a 2½ ton crane and 1½ yd. bucket. Bulk cement was pumped 200 ft. from box cars on a siding. Seven dump trucks were required for maximum production at 65 yds. per hour and scaled down proportionately as the yardage dropped.

The job was in a congested district, in a locality where Truck-Mixers are not in use and sidings or storage space are seldom available. It is customary to dry-batch to pavers on a contract of this nature. The saving in wet-batching was estimated 40 cents per cu. yd. in this instance.

Labor Force and Per Cu. Yd. Placing Cost in Man-Hours

Overall average placing rate per hour—30 to 35 cu. yds.

Classification	*No. of Men*
Plant Crew:	
Crane operator	1
Mixer operator	1
Batcher man (also handled cement blower)	1
Labor for cleanup, etc.	1
Truck drivers (average)	5
Foreman	1
Pumpcrete Crew:	
Pump operator	1
Oiler	1
Labor (dumping and cleaning trucks)	1
Distributing Crew:	
Concrete labor (average)	5
Finisher (average)	1
Finisher helper	1
Foreman	1
Total crew required for operation	21
Man-hours per cu. yd. at 32 yds. per hour	.66
Plus pipe handling (includes scaffolding, etc.)	.20
Plus 10% for maintenance, labor and incidentals	.09
Total man-hours per cu. yd. for concrete in place, exclusive of overhead, insurance and taxes	.95

Remarks

Concrete labor varied from 4 to 6 men, according to the type of pour. Usually 6 men on wall pours and 4 on slab. Pours were occasional throughout the job, so the 4-man concrete crew handled practically all the pipe work except scaffolding.

LOCKS and DAMS • POWER DEVELOPMENT PROJECTS, Etc.

The nature of such construction with its preponderance of mass concrete usually dictates a placing speed at least equivalent to the maximum output of a 1 yd. mixer, even on fairly small jobs. However, the 160 or 180 will often prove practical in this field as shown in Figure 40 (Model 180), and Figure 44; particularly so in the construction of moderate sized spillways and by-passes built in connection with earthwork storage dams.

Starting in the latter part of 1932, Pumpcrete placed some 290,000 cu. yds. in the power house, diversion tunnel plugs, etc., at Boulder Dam. Later the larger units were used extensively on the Mississippi River Lock and Dam projects, Muskingum Valley and numerous other flood control dams and on several large western projects. More recently all model pumps have been and are being used on Hydro-Electric development of various types, miscellaneous storage dams and spillway structures, etc., all over the continent.

180,000 cu. yds. were pumped into Bartlett Dam in Arizona by the Barret & Hilp and Macco Corporation with a Model 200 Double. This dam is approximately 700 ft. long at the crest and rises to a height of 286.5 ft. above the stream bed.

Figure 38—Pipeline on Trestle—Bartlett Dam.

The following data on this project are reprinted from the November 1938 issue of the Western Construction News:

"Another world record for dam construction is being established in the West with the building of Bartlett Dam—a 286.5 ft. structure of multiple arch type. When completed, Bartlett Dam, being built by the U. S. Bureau of Reclamation on the Verde River in Arizona, will exceed by about 30 ft. the existing record for multiple arch structures—Lake Pleasant Dam—which, by coincidence, is located 50 miles away on the Agua Fria River. Bartlett Dam will store 200,000 ac. ft. of flood runoff on the Verde River to provide a supplemental irrigation supply for lands of the Salt River Valley Users' Association in the vicinity of Phoenix, Arizona. Contract is being carried out by Barrett & Hilp and Macco Corp., and the project is scheduled for completion in May, 1939."

"Aggregate and concrete mix: Aggregate is produced from stream-bed gravels excavated and processed about a mile below the dam site. A deficiency of fines, which was known before the job started, has been relieved by the introduction of quantities of fine sand deposited by the river a distance of about 3 miles downstream. During one stage of concrete placing, this blending sand formed as much as 30% of the sand in the mix, but improvement of the raw material and selection from the main deposit have reduced this to about 15%.

Concrete Characteristics

Weight of materials in 2 yd. batch:

Cement	930 lb.
Sand	2370 lb.
$\frac{3}{16}$-¾"	1595 lb.
¾-1½"	1360 lb.
1½-3"	1590 lb.

Cement—1 Sand—2.55 Gravel—4.90

Water-cement ratio	.58
Gravel-sand ratio	1.98
Cement per cu. yd. of concrete	1.23 bbl.
Fineness Modulus about	2.80
Strength	3100-3300 lb. at 28 days

Sand Grading

No. 4	1.3%	No. 28	57.2%
No. 8	11.7%	No. 48	83.0%
No. 14	31.5%	No. 100	94.5%

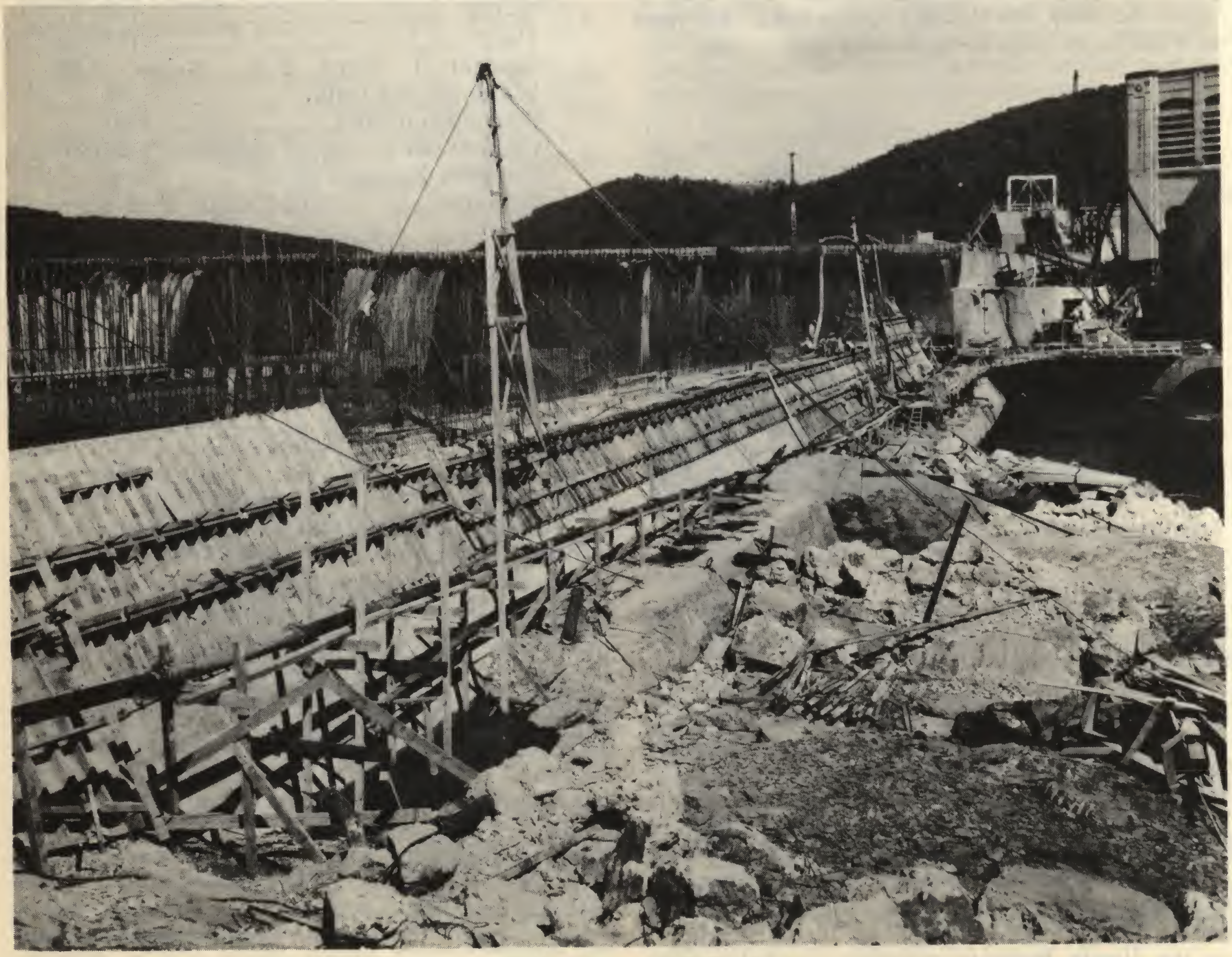
"Concrete Placing: Practically all of the 180,000 cu. yds. of concrete in the structure has been handled from mixing plant to point of placement by concrete pump. The exception was a small yardage of concrete placed in the river section which was handled by truck from the mixer. The concrete pumping setup has involved a total actual horizontal distance of 975 ft. and when the usual allowances are made for bends, this brings the total pumping distance to 1150 ft.

"In the lower section of the structure, the pumping unit was located at the mixing plant and discharge was made directly into the pump hopper. Later the pump was moved to a higher position on the abutment, and a 2 yd. bucket operated by inclined cable is now used to handle concrete from the mixer to the pump. The contractor has built a small repair and maintenance building around the pump unit to facilitate overhaul and repairs. The present pump has handled about 150,000 cu. yds. to date, and it is expected that it will complete the placing of all concrete in the structure.

"Sequence of concrete placing operations involves the combined factors of available forms and specification requirements. Buttress and exterior arch forms must be kept in position 24 hours and the inside arch forms must remain in place for 72 hours according to field requirements. Lifting of a complete buttress form for a 10 ft. pour requires a complete shift, with another shift required to place steel. On the arches, the time for forms to remain in place plus the time required for moving and setting steel, provides a 6 day cycle between pours. Sufficient forms are in use to maintain concrete placing at a rather steady rate of two shifts per day. During maximum placing operations, the maximum hourly rate has approached 60 cu. yds. Maximum concrete placed during any week has been 4150 cu. yds."

Figure 39—1700 cu. yds. placed in concrete spillway for earthwork, storage dam, McLean, Texas. U. S. Dept. of Agriculture. Model 180 Pumpcrete.

Figure 40—Spillway outlined in Mr. Utegaard's letter on the opposite page. Model 180 Pumpcrete.



CONSOLIDATED WATER POWER & PAPER CO.

GENERAL OFFICES

WISCONSIN RAPIDS, WIS.

March 13, 1937

Mr.C.I.Longenecker
Chain Belt Co.
Milwaukee, Wisconsin

Dear Sir:

This reply to your letter of February 27 is tardy because the writer has been away for several weeks.

The Pumpcrete which we used on our spillway job at Biron last summer lived up to our expectations in every respect. Including all items of cost except depreciation of equipment it cost us about 18¢ per cubic yard to move concrete from the mixer to the forms. Slump never exceeded two inches and was usually under one inch. Test cylinders broken at 28 days showed an average compressive strength of concrete of 4420 p.s.i.

We feel that our selection of a Pumpcrete was more than justified by its use on this job alone, and in spite of the fact that the site of the work increased the cost of materials delivered to a figure above what we usually experience, our unit costs for concrete in place were the lowest we have ever accomplished on comparable work.

Very truly yours,

CONSOLIDATED WATER POWER & PAPER COMPANY

T. Utegaard.

Engineering Department.

T.Utegaard
CD

Matteceunk Power Station at Mattawamkeag, Maine. Recently completed by the Great Northern Paper Co.

71,000 cu. yds placed with a Model 200 Double Pumpcrete and 8" pipeline. Maximum distance pumped—1150 ft. with allowance for ells and risers.

Proportions of mix by weight ____ 1 x 2.25 x 4.25
Coarse aggregate ____ 2" stone
Average slump ____ 3"

This concrete produced a 28 day strength of from 3800 to 4000 pounds.

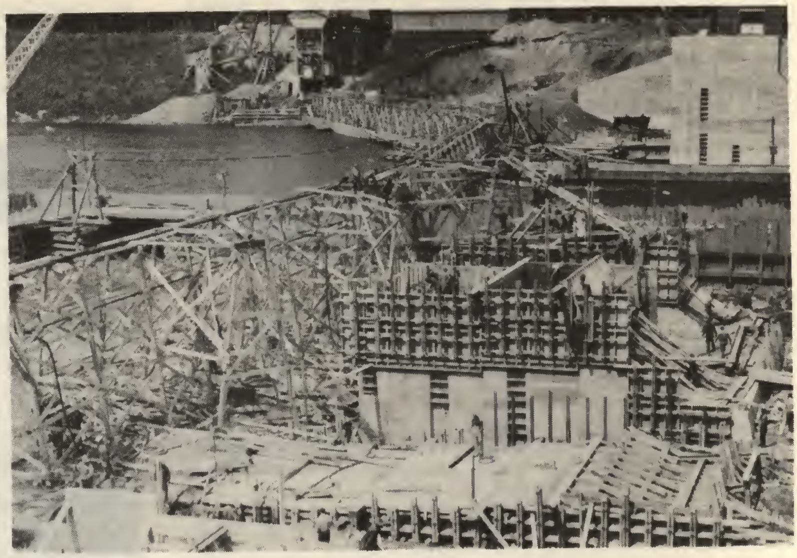


Figure 41—General view showing plant setup and trestle for pipeline, with laterals cutting into the arterial line.

Figure 42—Method of distributing concrete by means of ladder chutes.

Figure 43 (Above)—10,000 cu. yds. placed in core of masonry dam with Model 180, Eureka Springs, Arkansas. U. S. Dept. of Agriculture.

Figure 44 (Right)—17,000 cu. yds. placed in Winfield, West Virginia, Power Plant. Boso & Richie, Contractors. Model 180 Pumpcrete, 7" pipeline. Note cableway for handling forms and reinforcing.

Subzero Concrete Pumping

F. A. Dale

Hydro-electric Engineer, Nepsco Services, Inc., Augusta, Me.

Pump placement of concrete in a northern Maine winter required no unusual frost protection

Constant progress in the pump placement of concrete was recorded during the past winter at Solon dam on the Kennebec River in northern Maine. Temperatures were as low as —20 deg. F. Pumping met the severe frost conditions in a rather scattered layout of structures as shown by Fig. 1. To advance the story a little, some of the questions that came up during the study of plant layout have been answered as follows:

1. There is no need of insulating the concrete pipeline to prevent freezing or excessive drop in temperature. With an air temperature of —12 deg. the concrete dropped only 6 deg. with an exposed pipeline length of 280 ft.; the pipe was prewarmed by steam before pumping was started.

2. Slumps as low as $1\frac{1}{2}$ in. at the mixer were pumped without difficulty. Thick grout for surface bonding was readily pumped and it was possible to alternate from grout to concrete or from concrete to grout by simply changing valve settings.

3. In some cases the pipe discharge was 29 ft. below the pumping machine. No segregation or plugging occurred, although care was taken to have any steep drops followed by enough friction to counteract the drop, thus preventing separation of the concrete column in the drop.

4. Pumping could be stopped at least 20 min. without plugging. This was ample time for changing chutes or shifting points of discharge along the pipe. Ordinarily only a few minutes stop was required for these purposes.

5. Transporting the concrete from pipe outlet to final destination in the form was satisfactorily accomplished by coal chutes. Lengths of from 5 to 10 ft. were found to cover all conditions and were conveniently handled where the clear width, within the form, was 3 ft. or more. No separation of the concrete stream was caused if the chute slope was just steep enough to keep the concrete moving; this minimum slope was found to range from 4 vertical to 12 horizontal (1 on 3) for 4-in. slump, up to 7 on 12 for $1\frac{1}{2}$-in. slump. The chutes were suspended at the correct angles by wires attached to the form tie rods. Fig. 2 shows a typical arrangement of chutes in a pier form.

6. Behavior of concrete during transportation is dependent on the shape and grading of the aggregates and on the mix proportions. Some variation in the above data might therefore be expected for different concretes.

Placing lessons

The aggregates were two sizes of stone and two sizes of sand, the separation being $2\frac{1}{2}$ to 1 in., 1 to $\frac{1}{4}$ in. and minus $\frac{1}{4}$ in. The aggregates were stockpiled over a reclaiming tunnel before severe weather set in and were transferred to the batching-plant storage bins by belt conveyors. Batching was by weight for the aggregates and cement; water was measured by an adjustable siphon volumetric tank.

All concrete was puddled by internal electric vibrators; in addition, unformed surfaces were consolidated by a surface vibrator consisting of an internal vibrator mounted horizontally on a 12x48-in. board. It was necessary to have the forms very tight; otherwise water is driven through the joints between boards, carrying cement and fine sand with it and causing a narrow sand streak on the concrete surface along the open joint. The steepest surface possible without forms, using 2-in. slump concrete vibrated, was 1 vertical on $3\frac{1}{2}$ horizontal. Steeper slopes were roughed formed, stripped after 1 to 2 hr. and the surface floated.

Horizontal construction joints were defined along exposed edges by pouring against a grade strip fastened to the form; in from the edge the joints were left irregular. From 6 to 10 hr. after a pour, the bonding surface was cleaned by a high-pressure jet of air and hot water. This removed some of the surface mortar without disturbing the coarse aggregate and left a rough surface. The jetting must be done at the right stage of set when the mortar will cut but the stones will not become loosened.

Anticold measures

No difficulty was experienced from frozen stone since the sizes used were self-draining in the stock pile. The sands were wet and the surfaces of the pile froze to a depth of several feet. As the craters above the tunnel gates formed and enlarged, it was necessary to break up the frozen surface lumps by using live steam at the pile. No difficulty was experienced in the flow of any of the aggregates from the storage bins, the bin sides having a slope of 1 vertical to 1 horizontal.

The entire batching and mixing plant was enclosed and heated. Dry steam coils surrounded the aggregate storage bins and in addition, live-steam connections into the bins were provided. Live steam was necessary only in very cold weather; its use made the control of mixing water difficult.

One advantage of pumping concrete at low air temperatures is that the form can be completely enclosed on top and the pipe line over the form included within the enclosure. The entire space involved in the placing operations can therefore be kept warm. As a result, the freshly placed concrete is protected from freezing without the need of high placing temperature and the efficiency of the workmen is greatly increased. On only one occasion was concreting postponed on account of low temperature within the form; a strong wind down the river with zero temperature delayed operations for half a day.

With a large area of surrounding ledge continuously exposed to cold, it was impossible to heat the rock base of a pour much above freezing. Concrete for bottom pours was therefore kept down to about 40 deg. F. placing temperature so as to reduce the maximum difference in tempera-

· ENGINEERING NEWS-RECORD · September 29, 1938

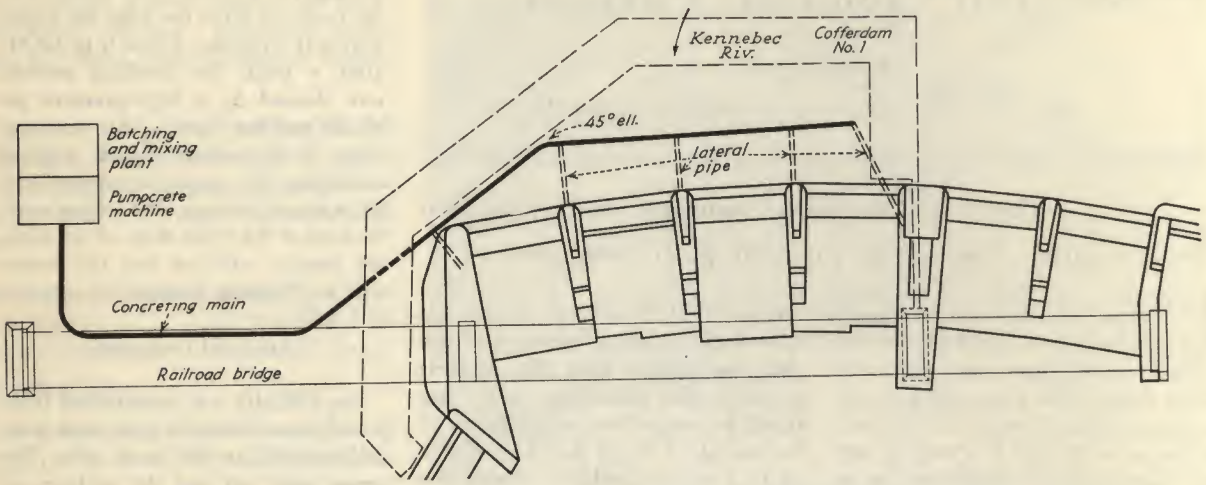


Fig. 1. Solon dam and pipe line and chute arrangement for placing concrete by pumping in subzero weather.

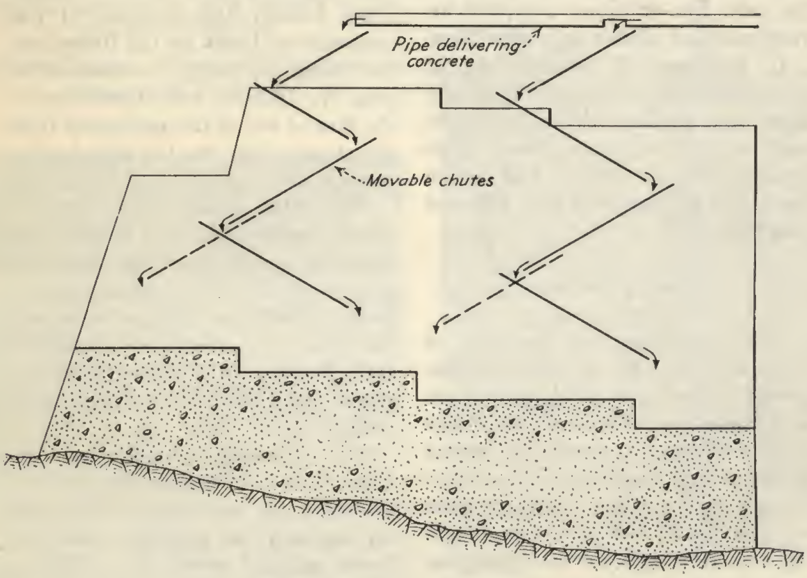


Fig. 2. Chute arrangement for distributing pumped concrete inside the pier forms.

ture between concrete and ledge and thus reduce the tendency of the concrete to crack when cooling. In mass spillway pours where most of the heat of hydration had to be dissipated from the top surface, the base pour was limited to about 5 ft. deep. The covering pour was placed after the pour below had passed its maximum temperature but before it had cooled below about 50 deg. F. Concrete was protected from freezing for two weeks after pouring. After the forms were stripped, tarpaulin covers with live steam jets beneath were used.

Fig. 2 shows a typical pipe and chute arrangement for a pier pour. The pipe is hung from a cable which is supported independently of the form so that pipe motion is not transmitted to the form. Pipe bends must be anchored securely to resist the impulses of the pump pistons. After each pour the concrete in the pipe line is reclaimed and the pipe cleaned, by breaking the line at the pump, inserting a go-devil and forcing it through with air or water. Air works satisfactorily for lengths up to 400 ft. with 90 lb. pressure. The pressure must be shut off before the go-devil reaches the end of the pipe, otherwise the explosion of suddenly released air is rather violent. The position of the tail end of the concrete column can be easily followed by hammering the pipe. For a length of more than 400 ft., air pressure is not sufficient and water is pumped by the concrete pump with valves set to full closure. With this method, pumping is stopped just before the water reaches the end of the pipe and the water is drained out by opening the pipe at a low point.

The cost of handling aggregates and concrete amounted to \$1.70 a cu.yd. This is the labor cost for: Handling aggregates from stock piles to batcher bins, batching, mixing, transporting and placing concrete, including labor operating the pumping machine and installing pipe lines. The cost of heating aggregates and concrete, before and after placing, amounted to \$0.39 per cu.yd.

The capacity of the twin pump was about 37 cu.yd. per hour with 2-in. slump concrete, and higher for larger slumps. The 1-yd. mixer limited the plant output to about the same figure with 1½-min. mixing time. The actual rate of placing varied from 20 to 29 cu.yd. per hour depending on the amount of delays in preparation of the forms.

The Solon dam is being built for the Central Maine Power Co. under the direction of Frank Mason, chief engineer. The writer acted as Mr. Mason's representative and A. C. Blake was concrete technician. The Sanders Engineering Co. was the contractor, with J. A. Hamilton as superintendent.

Figure 45—Mississippi River Lock No. 4, Alma, Wisconsin. Ouilmette Construction and Engineering Company.

Figure 46—Lock and Dam No. 5, Green River. Frazier-Davis Construction Co

TELEPHONE KEARNY 6408

T. E. CONNOLLY
CONTRACTOR
SHELDON BUILDING
SAN FRANCISCO

SAN FRANCISCO, CAL. January 6, 1936.

Chain Belt Company
366 Brannan Street
San Francisco, Calif.

Gentlemen:

We thought you would be interested in being advised of our experience with the REX Dual Pumpcrete which we purchased from you in the summer of 1934.

The machine has been used on our contract to build the tunnel for the San Francisco-Oakland Bay Bridge, through Yerba Buena Island. As you probably know, this tunnel is the largest one ever built in the world. It is a horse-shoe shaped tunnel excavated, 82 feet wide, 56 feet high and 540 feet long. The condition of the rock was such that it was necessary to leave the core in place while concreting.

In handling the work, we first drove cuts for the side walls which were then poured with your Pumpcrete; then we mined out and concreted the arch a section at a time. We placed 180 - 16", 78# I-beams in the arch; it was necessary to pump concrete all around these steel beams and pack the arch so as to get a smooth consistent finish.

All pumping of concrete was from one location. The largest distance we pumped was 600 feet long and 60 feet high in one pipe-line. Our rate of pouring was controlled by the conditions of the job, but we got fifty yards per hour when we needed it. All concrete was 2" slump with maximum aggregate of 2½" in the mix. Engineers who inspected the work were particularly pleased with the consistency of the concrete, lack of segregation and perfect packing of the arch.

We have found the REX Pumpcrete a good tool for placing concrete at a reasonable cost and we do not hesitate to recommend this equipment to anyone interested in construction work.

Signed T. E. Connolly

Pumpcrete definitely provides the most economical method of handling concrete ever to be employed in tunnel construction. It also produces, without question, a sounder and higher quality concrete structure than any other equipment or method used in this class of work.

Starting with the Casper-Alcova project in 1933, several million cubic yards of concrete have been pumped into tunnels. 1,100,000 cu. yds. were pumped into one project alone—the Colorado River Aqueduct in Southern California. Special tunnel lining units consisting of Mixer and Pump were developed for this project. Some of the single cylinder units pumped well over 100,000 cu. yds. each and are still going strong on other classes of work. Tunnel liners have been further developed in meeting constantly shifting requirements until today a self-propelled double 200 Pumpcrete and two-compartment Mixer, capable of delivering 65 cu. yds. per hour, is available for circular tunnels as small as 13'-6" in diameter.

On the Chicago Subway, under construction at this time, approximately 390,000 cu. yds. (over 80% of the total volume) has been or is being placed by standard Pumpcretes. Seven of nine contracts were pumped.

The City of Minneapolis pumped several miles of sewer tunnel running in size from 3'-6" x 6'-0" to 9'-6" x 9'-6" as outlined in the reprint from the June 11th, 1936, issue of the Engineering News-Record on page 42.

Tunnels of all sizes and types, from the 78' x 56' Yerba Buena Tunnel for the San Francisco-Oakland Bay Bridge (outlined in Mr. Connolly's letter on the opposite page) down to the smallest sections that can be handled by any sort of mechanical equipment, have been lined economically and in record time by the Pumpcrete.

Jobs and methods are analyzed in detail in another bulletin, "Tunnel Lining With the Rex Pumpcrete."

Job No. 1

54" CIRCULAR SANITARY SEWER TUNNEL FOR THE CITY OF GARY, INDIANA

Using a Model 160 Pumpcrete with 6" pipeline, George Pontarelli of Chicago completed this contract in a period of three months after concrete operations were started in October, 1939.

Mr. Anthony Pontarelli, who supervised the job, sends in the following breakdown on the procedure:

General Procedure

Working shafts were dropped at all manhole locations, 400 to 600 ft. intervals. The tunnel was holed through between shafts and the invert was poured daily (spreading by hand from dump cars), as headings were advanced. The Pumpcrete was set up near each shaft in turn as they were completed and used to place the arch concrete.

Overall length of contract—2588 ft.

Total concrete, with over run — approximately 1900 cu. yds.

Arch concrete placed by Pumpcrete — approximately 1300 cu. yds.

Invert concrete placed by hand—approximately 600 cu. yds.

Proportions of mix by weight___1 x 2.75 x 3.75

Coarse aggregate ____1¼" crushed limestone

Average slump, arch concrete__________4½"

Pumpcrete charged by Truck-Mixers. Maximum distance pumped—500 ft. Average rate of pumping when not delayed by concrete trucks — 10 cu. yds. to 12 cu. yds. per hour, including delays for removing arch pipe and lagging up for keyway.

Figure 47—Arch pipe going into form in 54" Circular Tunnel.

Average form poured daily when tunnel was available, was 50 lin. ft. (25 cu. yds. approximately). After the crew became accustomed to the procedure, 64 to 78 ft. of form was poured daily on the regular shift.

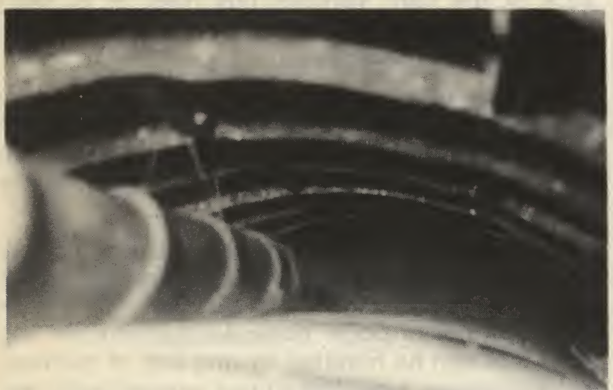


Figure 48—Arch pipe laying on reinforcing in form. Note concrete is solidly packed.

Method of Using Pumpcrete

Pipe was dropped down shaft and laid on invert to far end of pour in the back heading so that forming was continuous. Forms were steel rings and wood lagging. Pipe was carried over the form from the invert by means of a 45 degree riser and rested on the top steel. The arch pipe was made up of 5 ft. sections of light gauge spiral weld with Victualic couplings.

Key lagging was left off back of the discharge pipe and two or three pieces of top steel weie left loose at intervals to facilitate removal of pipe sections.

In starting a pour, concrete was pumped up to the key, then packed into place by means of an air booster connected on the top 45 degree ell. After the end was filled, a 5 ft. section was removed, lagging set up and the process repeated. A 110 ft. portable compressor with a 50 ft. receiving tank supplied the air. A 60 ft., 6" arch pipe required the full output of a 110 c.f. compressor when keying off.

Concrete Procedure

Crew No. 1, the form gang, checked in at 12 o'clock midnight, set up top steel, stripped and started setting rings and lagging.

Crew No. 2, the concrete gang, checked in at 8 a. m., finished setting lagging, set up arch pipe, poured concrete and cleaned up.

Labor Force Required for Forming and Concreting Operations on Arch Concrete

Classification	*No. of Men*	*Total Hours*
Form Crew:		
Tunnel labor	3	24
Foreman	1	8
Concrete Crew:		
Pumpcrete operator	1	8
Top labor (utility)	1	8
Tunnel labor	3	24
Foreman	1	8
Totals	10	80

Total labor cost in man-hours per lineal ft. of tunnel for arch concrete at the rate of 50 ft. per working day, exclusive of final cleanup and moving Pumpcrete setup... 1.60

Note: 1—Labor for moving Pumpcrete per setup: The preceding crews for one extra day per 500 ft. of tunnel.

2—All pipe work in tunnel was handled by the concrete crew on their regular shift.

3—There was no other maintenance time against the Pump and no replacement of parts.

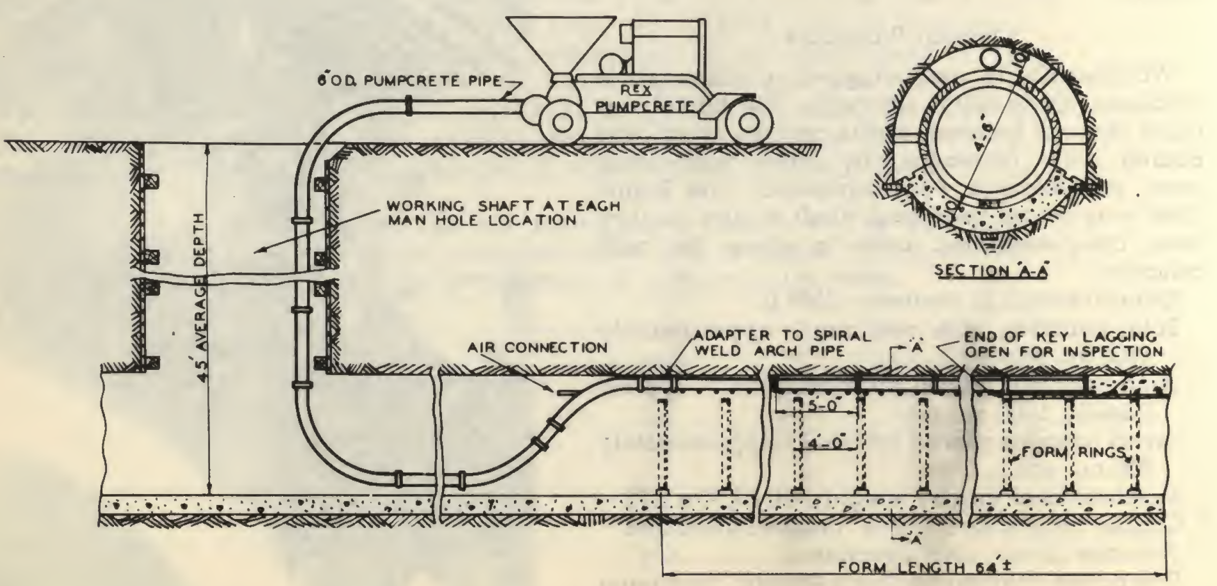


Figure 49—Profile illustrating concrete procedure.

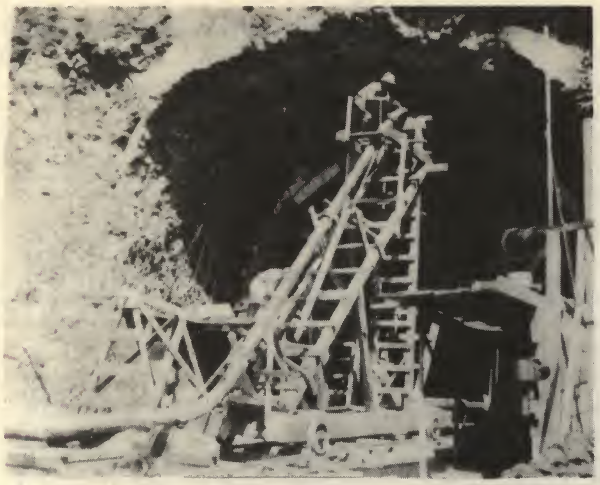


Figure 50—Gross & Stevens completing a highway tunnel at Gering, Nebraska.

Figure 51—Setup in 16 ft. diversion tunnel, Alcova, Wyoming.

Job No. 2

LEXINGTON AVENUE COMBINED SEWER, ROCHESTER, NEW YORK

7'-0" Finish

Contractor — Tomack Subsidiary, Inc., Rochester, New York.
Length of Contract—12,000 lin. ft.
Theoretical Concrete—.93 cu. yds. per lin. ft.

This tunnel drilled through bastard shale, 40 ft. beneath the surface, is being lined by a Model 160 equipped with a conical remixer and 6" pipeline; pumping both ways through drill holes spaced approximately on 1200 ft. centers where shafts are not available for the purpose. Some 7000 cu. yds. have been placed at the present writing.

Concrete is supplied from a central plant and hauled several miles in bath tub dump trucks. This operation was made possible by the reconditioning efficiency of the remixer.

Proportions of mix by weight ..... 1 x 2.5 x 3.4
Coarse aggregate .... 1½" gravel
Average slump .... 4"

The rather unusual design with a half section of 24" tile flow pipe in the invert—has necessitated an extra operation in placing concrete as shown in Figure 52. An average progress of 360 ft. per week has been maintained with 120 ft. of forms on the following cycle:

First Day—Set 240 ft. tile and pour to lines in Section AA Fig. 52. Average concrete volume 80 cu. yds.

Second Day—Set 240 ft. curb forms and pour to Section BB Fig. 52. Average concrete volume 90 cu. yds.

Third Day—Pour 120 ft. arch—Section CC Fig. 52. Average concrete volume 100 cu. yds.

Fourth Day—Pour 120 ft. arch as above. Average pouring rate is 14 cu. yds. per hour for operation 1 and 2 and slightly less on operation 3.

Labor Force Required for Concreting 240 Ft. of Tunnel 4 Day Cycle

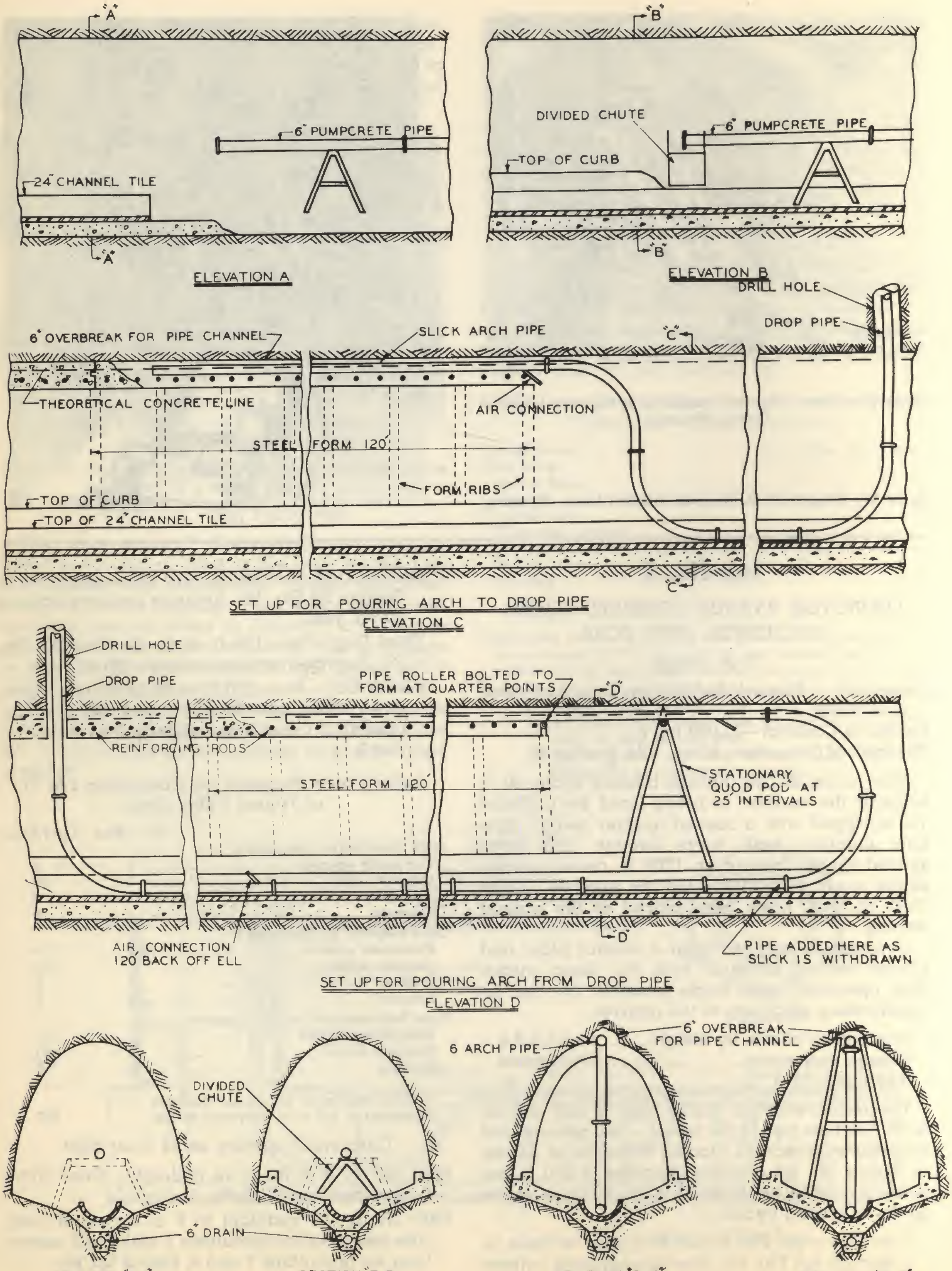
	No. of Men	*Total Hours*
Crew Required for Operation 1:		
Pumpcrete operator	1	8
Concrete labor	7	56
Tile setter	1	8
Foreman	1	8
Crew Required for Operation 2:		
Pumpcrete operator	1	8
Concrete labor	7	56
Finisher	1	8
Foreman	1	8
Crew Required for Operation 3 and 4:		
Pumpcrete operator	1	16
Concrete labor	5	80
Foreman	1	16
Total man-hours for actual concrete placement in 240 ft. of completed tunnel		272

Concrete Procedure on 24 Hour Shift

Shift No. 1—4 p. m. to 12 midnight: Crew trims bottom and sets 6" drain.

Shift No. 2—12 midnight to 8 a. m.: Four man crew sets steel for operations 1 and 2 and moves form for operations 3 and 4, cleans up, etc.

Shift No. 3—8 a. m. to 4 p. m.: Concrete shift.



"A"
6" PUMPCRETE PIPE
24" CHANNEL TILE
"A"
ELEVATION A
"B"
DIVIDED CHUTE
6" PUMPCRETE PIPE
TOP OF CURB
"B"
ELEVATION B
DRILL HOLE
DROP PIPE
6" OVERBREAK FOR PIPE CHANNEL
SLICK ARCH PIPE
"C"
THEORETICAL CONCRETE LINE
AIR CONNECTION
STEEL FORM 120'
FORM RIBS
TOP OF CURB
TOP OF 24" CHANNEL TILE
"C"
SET UP FOR POURING ARCH TO DROP PIPE
ELEVATION C
DRILL HOLE
DROP PIPE
PIPE ROLLER BOLTED TO FORM AT QUARTER POINTS
"D"
REINFORCING RODS
STEEL FORM 120'
STATIONARY "QUOD POD" AT 25' INTERVALS
AIR CONNECTION 120' BACK OFF ELL
"D"
PIPE ADDED HERE AS SLICK IS WITHDRAWN
SET UP FOR POURING ARCH FROM DROP PIPE
ELEVATION D
DIVIDED CHUTE
6 ARCH PIPE
6" OVERBREAK FOR PIPE CHANNEL
6" DRAIN
SECTION "A-A"
SECTION "B-B"
SECTION "C-C"
SECTION "D-D"

Figure 52.

Method of Concreting Lexington Avenue Tunnel

Elevation "A"—Setting tile in operation 1: The pipeline is carried on low horses, pouring starts at the far end and works toward the pump. Low slump concrete is placed several feet in advance of tile and carried above grade. The tile (strung along the side before starting) is set on line and tapped down to grade in the concrete.

Elevation "B"—Setting curb forms and placing concrete in operation 2: The pipeline is reset on the same horses, the pour again starts at the far end, works toward the pump. Concrete is discharged onto a dividing chute and spread behind the curb forms, which are carried on templates attached to tile setup on the previous pour. A short swivel spout could be used in place of the dividing chute on this operation.

Elevation "C"—Working toward the drill hole or Pumpcrete on arch concrete in operation 3 and 4: 120 ft. slick arch pipe riding just above the steel on rollers fastened to the form. As the arch fills up, the key is packed by the top air booster. When the key is packed up to the discharge pipe, both air boosters are blown in turn to clear the pipe; the 10 ft. section next the goose-neck is removed from the line and the arch pipe withdrawn 10 ft. This operation is repeated until the bulkhead end of the form is reached at which time key concrete is packed tight against the bulkhead by pressure from the pump. As the slick is withdrawn, it is carried on light stationary "quodpods," spaced approximately at 20 ft. intervals.

Elevation "D"—Working away from the drill hole on arch concrete in operation 3 and 4: The operation described is reversed when working away from the Pump. As the arch fills and the slick is blown out and withdrawn, a 10 ft. section is added to the line on the bottom. The finished invert is always carried at least one day in advance of the arch which leaves the pipe in place for the next operation.

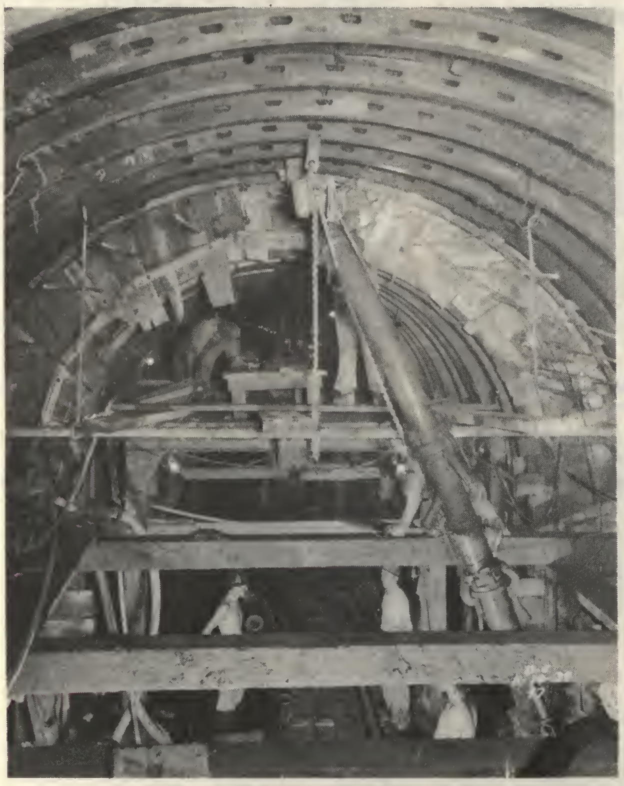


Figure 53—The end of an arch pour on the Chicago Subway.

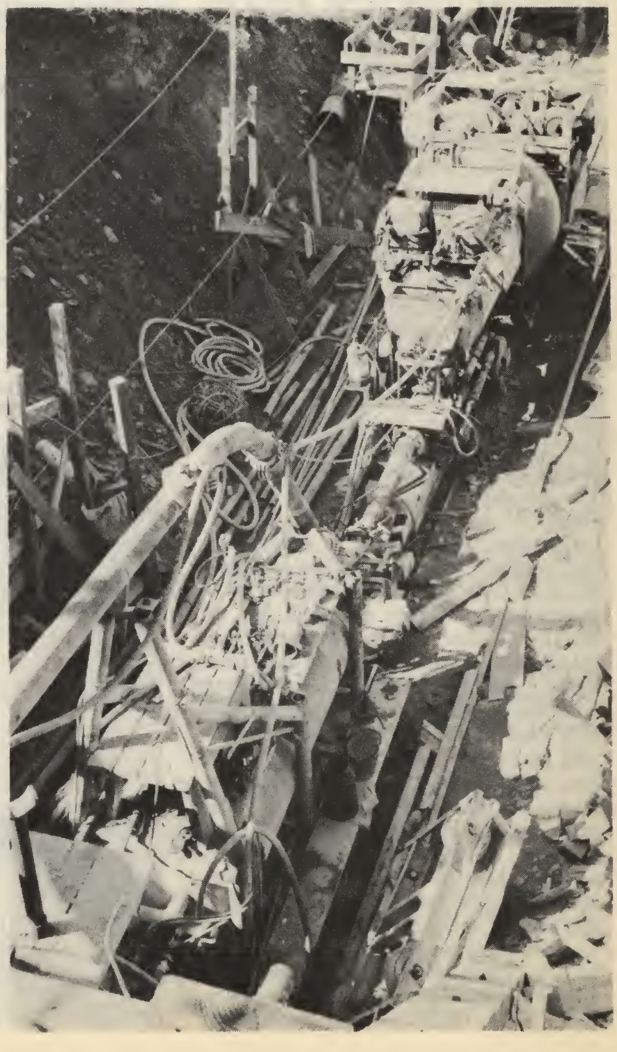


Figure 54—Bird's eye view of 200 single Tunnel Liner on last pour of Lock-Raven-Montebello Tunnel for City of Baltimore Water Supply. J. F. Shea Construction Co.

Reprinted from Engineering News-Record, June 11, 1936

Concrete Tunnel Lining Pumped Down Drilled Holes

Work on small-bore sewer tunnels in Minneapolis, carried out by three pumping units on surface fed by truck mixers, averages 60 ft. of lining per 5-hr. shift

By Emory D. Roberts
Professor of Civil Engineering
Marquette University
Milwaukee, Wisc.

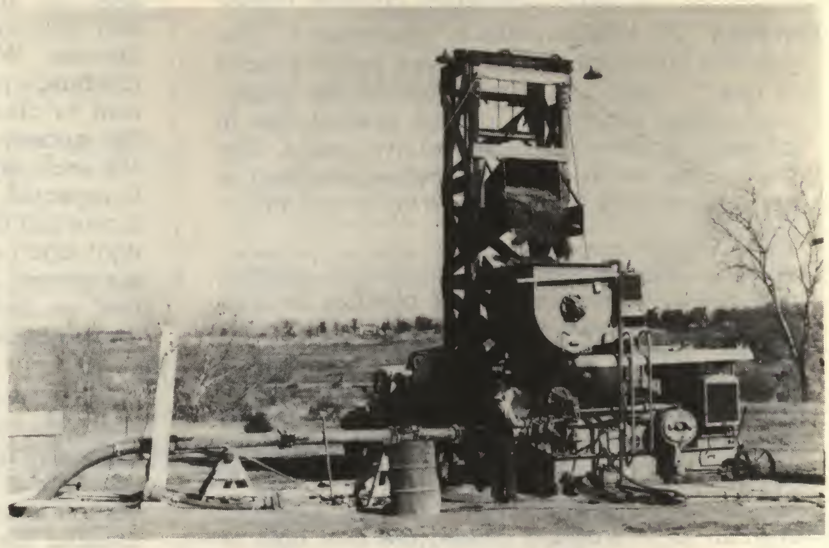


FIG. 1—THE SURFACE PLANT for lining small sewer tunnels in Minneapolis consists of a pumping unit charged by a skip hoist.

PUMPING of materials is a prominent feature in the construction of the Minneapolis interceptor sewer tunnel system. First, the sand-rock muck from tunnel driving, pulverized by light blasting, was mixed with water and pumped to the portal or top of shafts, and now the concrete for lining the small bores is being pumped into the forms from surface-level pumping plants located at intermittent well-drill holes along the sewer line. Both processes are innovations in small-bore tunneling, though concrete has been pumped into larger tunnels at Boulder Dam, on the Colorado River aqueduct and at Baltimore, while the rock pumping was developed concurrently with that on the larger main interceptor, in St. Paul.

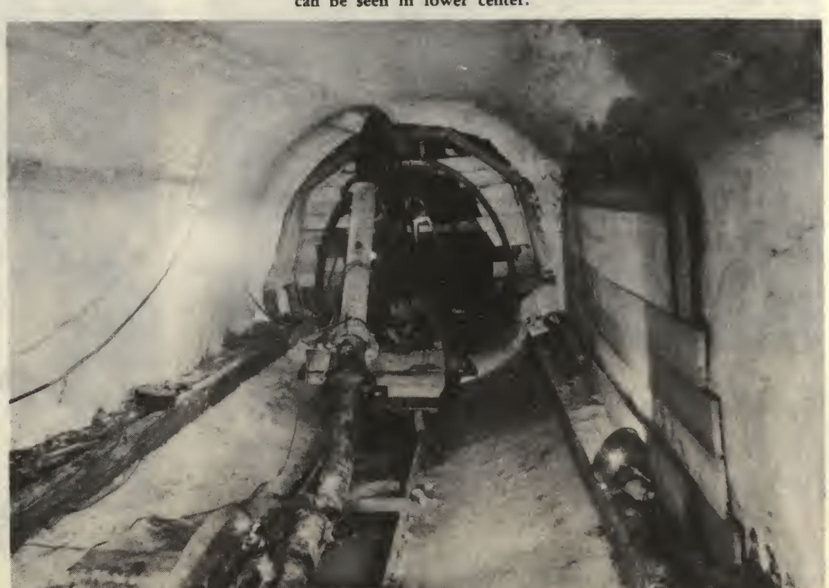
The Minneapolis tunnels, aggregating 16 miles in length, are part of a large sewage disposal program being conducted jointly by the Twin Cities to end pollution of the Mississippi River. The program involves local interceptor sewers in both cities, a joint main interceptor and a disposal plant, both located in St. Paul. An outline of the complete plan, and a description of the sand-rock pumping process appeared in *ENR*, Nov. 7, 1935, p. 627. The project is being financed through PWA.

Concrete lining work is being carried on simultaneously at three separate points. Each plant unit consists of a Pumpcrete machine, charged by an elevator bucket, 60 ft. of invert side forms, 60 ft. of sidewall and arch forms, and a 7-in. pipe line leading from the pumping plant through a well-drill hole to the forms. Work is carried on in two 5-hr. shifts daily. The first shift strips, moves and resets the forms; the second shift places 60 ft. of invert and 60 ft. of sidewall and arch concrete in separate sections. Minneapolis has long conducted its construction work by the day labor system, and all of the city's share of the intercepting sewer tunnels is being built by the sewer department, which submitted a low bid to PWA in competition with contractors. Department officials report the work is costing less than bid prices.

Several systems considered

Before selecting the method to be used in placing the concrete lining, the sewer department made a careful study of equipment available and systems in use. There are four sizes of tunnel involved; 3½x6 ft., 5½x6 ft., 8½x8½ ft., and 9½x9½ ft. Naturally, those in charge wanted to select a plant applicable to all four sizes with a minimum of change from one section to another. The plant study revealed that the concrete pumping system had the advantage over all other mechanical placement schemes in that it could handle the smallest of the four sizes of tunnel as well as the other three. Any other plan of placement would have necessitated more expensive hand placing on the smallest section in exceedingly cramped working quarters. As all of the tunnel sections were readily accessible through well-drill holes from the surface, 60 to 85 ft. deep, pipe delivery of concrete to the forms had a distinct advantage over haulage from the bottom of shafts. Furthermore, the pumping method had an advantage over other systems of pipe delivery because of ability to transport concrete a

FIG. 2—THE UNDERGROUND PLANT is a pipeline extending into the top of forms. Compressed air connection for giving the concrete a final kick by a slug of air can be seen in lower center.



greater distance from bottom of well-drill holes, thereby reducing the number of holes required, resulting in a cost saving of $5,000 to $7,000.

The concrete lining plant as finally developed consists of three pumping units at the surface fed by 1½ yd. transit mixers, which are charged at the city's central batching plant, involving a maximum haul of 5 miles. The tunnel line is tapped by well-drill holes spaced a maximum of 1,600 ft. apart. As the scheme of operations provides for pumping of concrete, in both directions from the bottom of a well-drill hole up to a distance of 800 ft., half the time lining progress is towards the hole and the other half is away from the hole.

Operation of system

A weighing batcher, receiving sand and gravel by derrick charging from stock piles and cement by belt conveyor from a warehouse, charges the transit mixers at the central batching yard. A standard batch is nine sacks of cement, 2,268 lb. of sand and 3,276 lb. of 1½-in. gravel. From tanks on the truck mixers 54 gal. of water (6 gal. per sack of cement) is added to the batch, which is mixed en route to the tunnels. The concrete, of 2 to 3 in. slump, and containing 5.4 sacks of cement per cu.yd., shows 28-day tests ranging from 3,746 to 6,648 lb. per sq.in.

Part of the fleet of truck mixers is city-owned, the rest are rented from contractors, and the sewer department pays the city rent for its mixers at the same rate paid to the contractors. At the job the mixers dump into a ¾-yd. tower hoist bucket, which elevates the concrete to a remixing hopper feeding the pump.

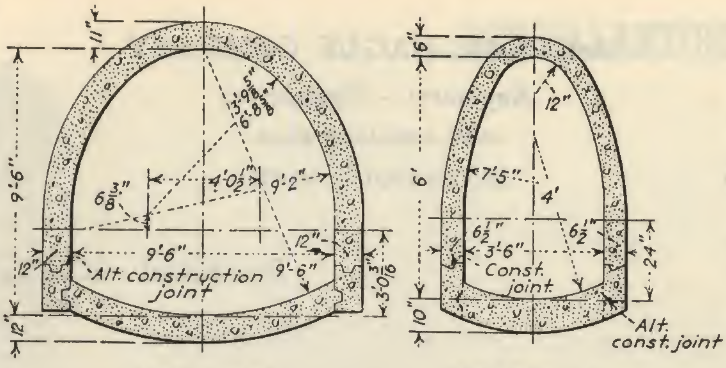


FIG. 3—DESIGN of the largest and smallest of the four tunnel sections. Pumping was the only satisfactory means for mechanical placing of lining in the small section.

Leading from the pump is a 7-in. discharge line, the first sections of which are horizontal with toggle connection joints. The vertical pipeline through the well-drill hole is welded in one piece 60 to 85 ft. long. At the bottom of this vertical length is a series of quarter and one-eighth bends forming a vertical double reverse curve, which retards the flow of concrete sufficiently to keep the vertical pipe full at all times. All of the pipe within the tunnel is in 10-ft. lengths with toggle connections. A tap at the bottom of the vertical pipe admits air for cleaning the horizontal sections within the tunnel in case of emergency.

The curved invert section, with a short height of lower sidewall, is poured ahead of the arch. No forms are used except those required for the wall footings as the stiffness of the dry mix allows screeding and troweling of the invert to proper curvature. Concrete for the invert is discharged directly into place from the supply line, which is temporarily supported on horses over the section being poured.

After the invert is in place, the remainder of the tunnel section is poured in one piece, with the supply line always discharging at top of crown. The piping arrangement varies with the direction of lining progress. When the progress is toward the well hole, the pipeline rises through two 45-deg. bends and a connecting tangent to the top of forms in a direct line (Fig. 2). When progress is away from the source of supply, the pipe passes through the bottom of the form and then curves upward and backward into the top of forms in the reverse direction (Fig. 4). In both cases final discharge is through a 60-ft. length of welded pipe that is withdrawn from the forms as the crown fills up by taking out or adding 10-ft. lengths of the supply line on the floor. The top horizontal line and connecting curves are all one assembly supported on a traveling carriage. The discharge end of the pipeline is kept buried in fresh concrete.

An airline is tapped into the concrete line at the bottom of the riser leading to the form. The admission of a slug of air at 110 lb. pressure at regular intervals, controlled by a quick acting hand valve, aids in packing this stiff concrete into the crown and forces the concrete into all of the overbreak sections. The arch form is vibrated from the outside with two air hammers applied at point of concrete placement.

The arch forms are collapsible steel sections 60-ft. long, carried on travelers, and set and stripped by means of a group of jacks. An air hoist on the form traveler provides the power for moving the section ahead, and is used also for moving the discharge pipe assembly carriage. Panel openings in the sidewalls of the arch forms, staggered at 10-ft. intervals on either side, provide means for observing the packing of the concrete and its slope in the sidewalls.

At the start of a concreting operation, a batch of grout is pumped through

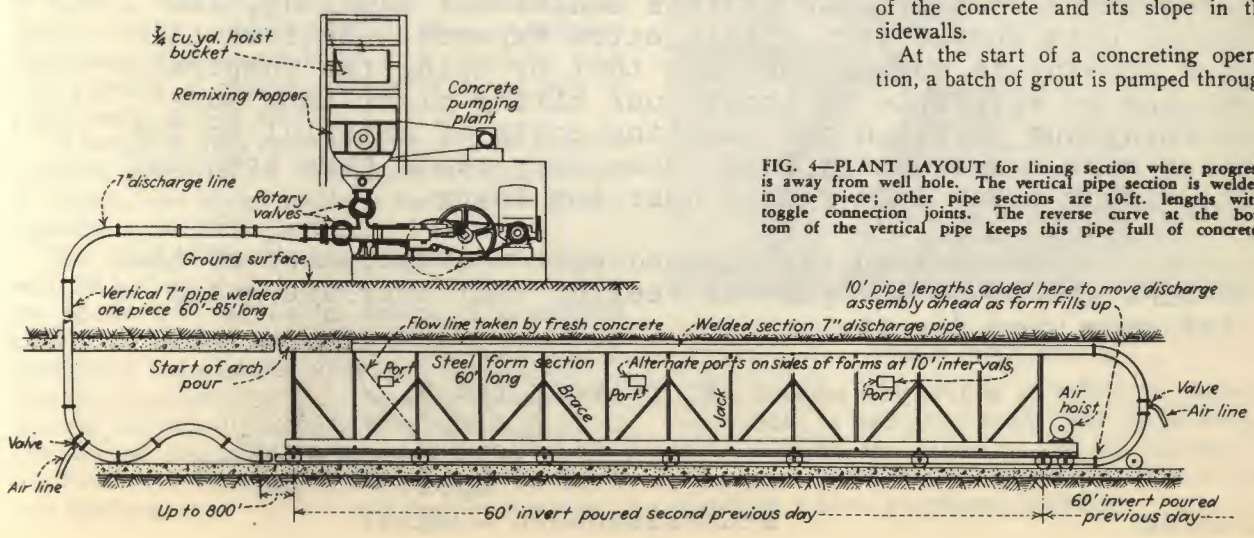


FIG. 4—PLANT LAYOUT for lining section where progress is away from well hole. The vertical pipe section is welded in one piece; other pipe sections are 10-ft. lengths with toggle connection joints. The reverse curve at the bottom of the vertical pipe keeps this pipe full of concrete.

McKENZIE-HAGUE COMPANY

Engineers - Contractors

CORN EXCHANGE BLDG.

MINNEAPOLIS, MINN.

Specialists in
Grain Elevators
Malt Plants
Industrial Buildings

December 22, 1939

Chain Belt Company
Milwaukee, Wisconsin

Gentlemen:

Your letter of December 18th addressed to our Mr. Bennison has been referred to the writer for answer.

We are pleased to inform you that the pumpcrete machine purchased by us this last season has handled a considerable volume of concrete in a very satisfactory manner. We had at first the idea that it would be useful to us in pouring concrete in the bottoms of grain bins at Decatur, Illinois. This has always been a very expensive class of concrete from the handling standpoint. It was handled very nicely with a pumpcrete machine saving fully as anticipated.

The machine was also used for distributing concrete to the various parts of the plant, and again in Shakopee, Minnesota where construction work made it necessary to move concrete from one side of a very active railroad track to the other. The pumpcrete machine performed very nicely for us and readily solved one of our handling problems.

While we regard the pumping of concrete as an additional operation in a case of this sort and had anticipated extra cost because of this additional handling, the actual cost showed very little extra expense. Believe this good showing is due to the fact that by using the pumpcrete machine we were able to locate our mixing plant in a more advantageous position and handling costs of material to the mixer were consequently lower than they would have been had the mixing plant been placed near the tower.

Our workmen are pleased with the operation of the machine and it is our general feeling that they are going to find many uses for it.

Yours very truly,

F L Hague
Mgr.

FLH/em

McKENZIE-HAGUE COMPANY

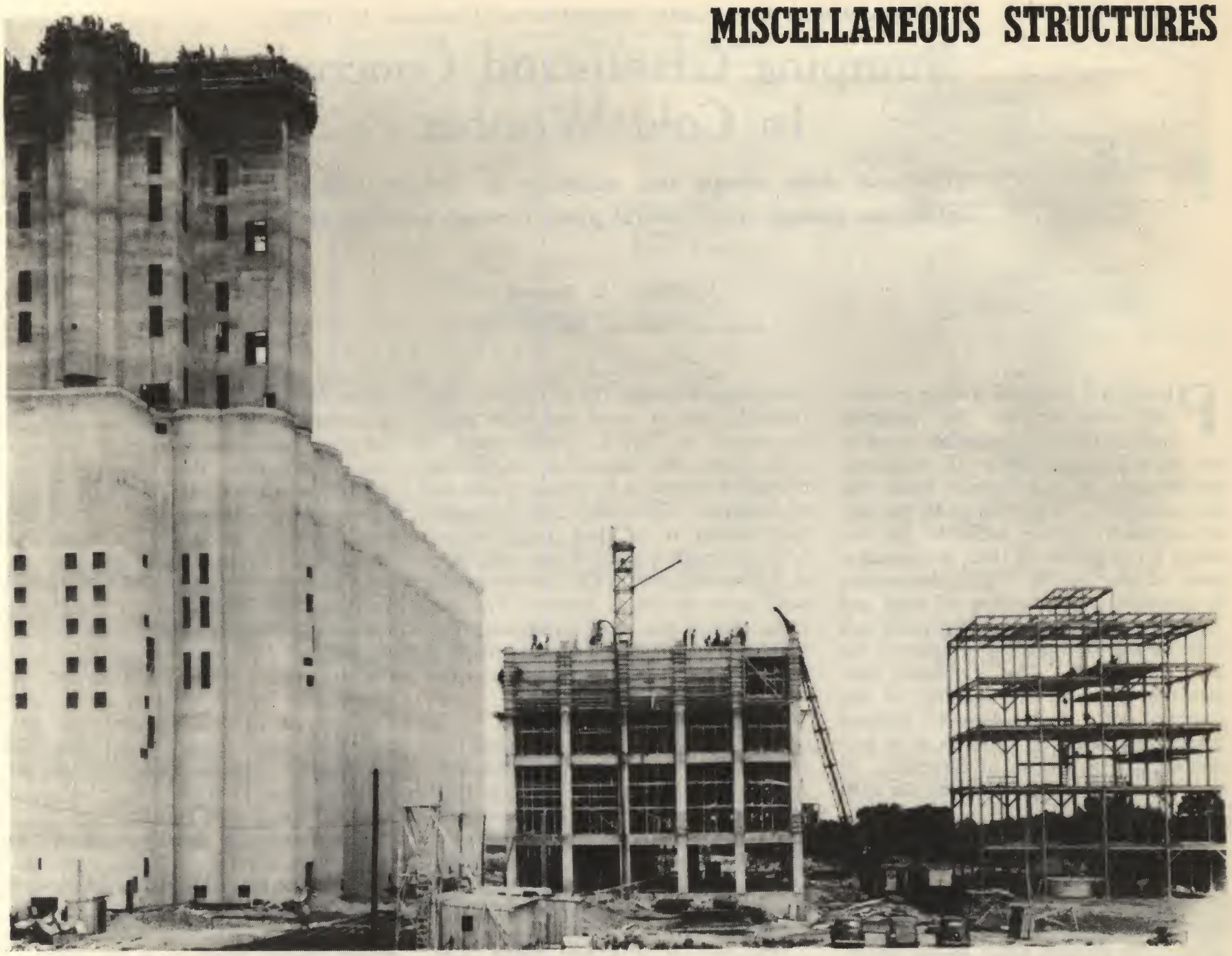


Figure 55—Soy Bean Processing Plant, Decatur, Illinois. McKenzie-Hague Co., contractors.

Bankhead Vehicular Tunnel

"Prefabricated, steel tunnel sections from 255 to 298 ft. long are being lined with concrete, floated to position and sunk in a trench at a maximum depth of 85 ft. under the Mobile River at Mobile, Alabama. The tunnel is 30 ft. in diameter and will provide a roadway width of 21 ft. with a police walk on one side.

"A length of 2100 feet including an 1100 ft. river crossing and 500 ft. on each shore, is being placed in trench, the shore sections being floated into position in wet coffer dams.

"The fabricated sections are launched and lined with 18 inches of reinforced concrete before they are floated into position for sinking. The sections consist of welded octagonal rings covered with inner and outer skins of welded steel plate. A blanket of concrete 2 to 3 ft. thick will be placed around the tube by tremie. The overall length of the tunnel including approaches, is 3,441 ft." (Quoted from February, 1940, issue of Construction Methods.)

Figure 56—Fabricated tunnel shells. Pumpcrete plant setup in background.

The Arundel Corporation of Baltimore, general contractors, is using two model 200 single Pumpcretes to place the 40,000 cu. yds. of concrete on this project. 35,000 cu. yds. in tunnel, 5,000 cu. yds. in a 50 ft. x 50 ft. ventilation building.

Reprinted from ENGINEERING NEWS-RECORD, NOVEMBER 19, 1936

Pumping Grandstand Concrete In Cold Weather

Thin seat slabs, ramps and walkways at Detroit ball park extensions poured from central plant through pipeline system

By Emory D. Roberts
Professor of Civil Engineering, Marquette University, Milwaukee, Wis.

PLACING concrete during extreme cold weather by the pumping method proved practicable last winter in the construction of additional grandstands at the Navin Field ball park, Detroit. Caught short by the lack of adequate seating facilities for the world series games of 1935, the management of the Detroit Tigers determined to complete the horseshoe of steel and concrete stands started some years ago to bring the total seating capacity of the park to 36,440. The additional construction involved the building of two sections of double-decked covered grandstands and the addition of a second deck to a section of bleachers, all to be ready for the opening of the 1936 season in April.

After the decision to proceed with the new construction had been made and designs were under way, the project was halted by the death of F. J. Navin, managing owner of the Detroit team. The ensuing delay, during which the club was reorganized, cut heavily into the already short time available for design and building of the additions. The new management decided to go ahead with the new work, though construction operations would have to be carried out during the cold-weather season.

Design

The new grandstands are made up of three units. Section A, which extends from the old concrete stands to the foul line, has two decks, a press box and a roof, the floor of the press box being 90 ft. above the playing field. Section B, of the same height, is somewhat narrower and has two decks, a press box and a roof. It fills the space between the old concrete bleachers and the foul line at the rear of right field These concrete bleachers (Sec. C) have been double-decked with a second deck that will not be covered for the present. Steel supports of the upper deck of the bleachers are independent of the old concrete columns carrying the lower deck.

The structures are of steel framework with concrete ramps, walkways and seat treads (Fig. 2). Several innovations in design are of interest, particularly that of tread and riser detail, as shown in Fig. 3. Steel risers of ¼-in. plate are supported on sloping channel floorbeams by gusset plates and clip angles. Continuous 2x2-in. angles, spot welded to the steel risers, carry a 3/16-in. tread plate. Upon this plate is a 2-in. concrete tread, for which the steel plate served as forms. The concrete treads are reinforced with No. 10 wire mesh. Joints placed every 30 ft. provide for contraction and expansion of the concrete treads.

Special chairs were installed in the covered sections. Their frames are fastened by lugs through slotted holes in the steel plate risers. The clear tread thus formed reduces the labor of cleaning. Similar slotting of the risers of the upper deck of the bleachers provides fastening for an angle supporting the 8-in. plank seats installed in this section.

Steel for the structures began to arrive by the first of this year, and erection commenced at once. By Jan. 15 about 75 per cent of steel for the larger grandstand was in place and much of the seat deck area was ready for concrete. At first the tower-and-chute method was considered for distribution of concrete. However, as the weather was extremely cold, with no signs of a break, the contractor decided that the loss of heat in the concrete by bucket hoisting and long chuting would be excessive, possibly resulting in serious damage by freezing. Furthermore, as the structures would have to be enclosed and heated to maintain proper concrete curing temperatures, the efficiency of the heating system would be impaired by keeping the top of the housing open, as would have been necessary to handle the chutes.

The contractor finally adopted the pumping method as best suited to the requirements of wide distribution with minimum heat loss. The plant arrangement was to place the concrete pump below ground level in a pit centrally located, and to install a 7-in. vertical riser pipeline from pump to highest

FIG. 1—CONCRETE PUMPED to top of new bleachers at Navin Field, Detroit flows through short chutes to final position in seat treads. The tread forms are fastened to steel risers through slotted holes that later will be used for seat fastenings.

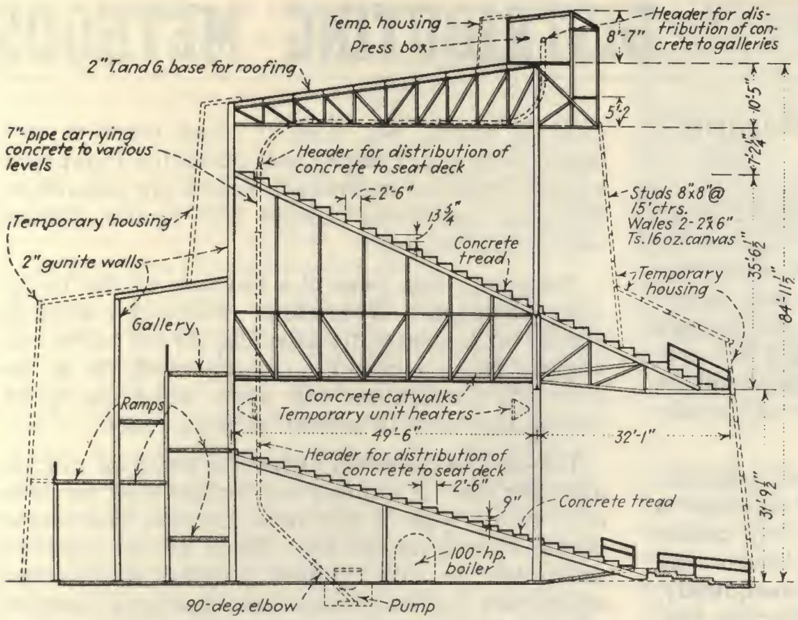


FIG. 2—NEW STANDS for Detroit ball park are structural steel, with concrete seat treads and ramps. This cross section shows the plant layout for the concrete pumping distribution system. The stands were enclosed in canvas housing and heated by unit heaters during construction.

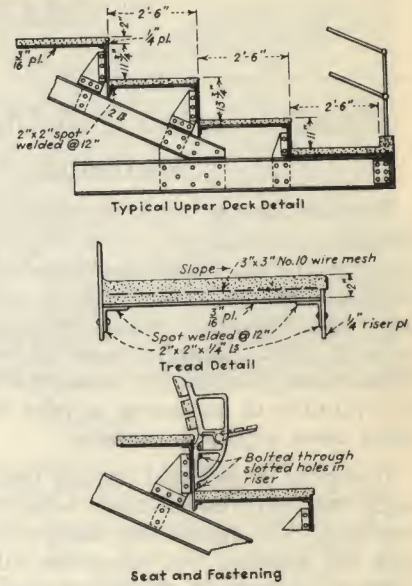


FIG. 3—UNUSUAL DESIGN of the seat treads shown in detail. The seats are bolted to steel risers, which leaves the tread clear for easy cleaning.

point of concreting, with horizontal headers leading off from the riser through quarter bends at various levels, as shown in Fig. 2. Chutes conveyed the concrete from headers down the inclined seat decks to points of placement. Additional pipe elbows changed the direction of flow when pouring ramps and catwalks.

Concrete was mixed in truck mixers with heated aggregates obtained from a central batching plant some distance from the job. The movement of mixer trucks was controlled so as to avoid delay at the pump and resultant loss of heat. The trucks discharged directly into the remixing hopper of the pump machine. Provisions were made for insulating the concrete pipelines if necessary, but experience showed that the loss of heat in the longest of the lines was only two or three degrees temperature between pump and point of placement.

The concreting schedule called for pouring the floor of the press box first. Catwalks leading to the press box were placed next, and the pipeline was broken up as operations moved back. The upper seat deck was next in order. Catwalks leading to the upper deck were then poured, followed by the lower deck and approach ramps. Paving of the ground under the stands was the last operation. Under this schedule no concrete was poured over that already in place, and trouble from dripping and spotting of new work was avoided. Despite the prolonged cold spell, the concreting kept up to schedule and the structures were completed within the allotted time.

The pump forced concrete to the highest points of the stands without difficulty. At one time it was working with 367 ft. of 7-in. pipe, including a vertical rise of 101 ft., with five 90-deg. bends in the line. In all, 1,300 cu.yd. of concrete was pumped, most of the yardage being in the 2-in. seat treads. Concrete was of two mixtures, both of a strength requirement of 2,800 lb. per sq.in. in 28 days. For the seat treads the maximum size aggregate was ½ in.; for the walks and ramps it was 1½ in.

For temporary heating during concrete placement and curing the two grandstands were completely enclosed by timber and canvas housing. This consisted of 8x8-in. studs spaced 15 ft. apart, carrying wales of two 2x6-in. planks spiked together in the form of a T. The timber frame was covered with 16-oz. canvas. A 100-h.p. boiler supplied heat through unit heaters placed throughout the stands (Fig. 2). The upper deck of the new bleachers was not enclosed, but fresh concrete was protected by tarpaulins, as shown in Fig. 1.

Direction

Both the design and construction of the new facilities were carried out by the Jerome A. Utley Co., of Detroit. P. C. Darin, general superintendent. Geo. Baseman, Geo. Armstrong and J. A. Fredman were the officials in charge of the work for the Utley company. The writer is consulting engineer for the Chain Belt Co., Milwaukee, which supplied the concrete pumping equipment.

CHAPTER IV DISTRIBUTING METHODS

Pipeline Setup and Distributing Methods

Pipeline setup and distributing methods go hand-in-hand as the most important factors in successful Pumpcrete operation where other conditions, concrete specifications, etc., meet pumping requirements. Failure to utilize the pump's natural advantages in meeting varying job conditions has resulted in unsuccessful applications in a number of instances on jobs that could easily have been highly successful.

It should go without saying that peak performance can only be attained when the machine is working. The fewer the delays from any cause, and the smaller the adequate labor force — the higher the rate of efficiency and, consequently, the more economical the operation. Concrete procedure should be carefully considered and laid out in advance with an eye to obtaining maximum progress with minimum effort; just as forming or any other phase of the job is so considered and so laid out.

Here is a method of placement highly adaptable to changing conditions. Because one job or one form has been set up in a certain manner, is not necessarily reason for repetition of the process time after time. Perhaps the next form or next job can be handled to greater advantage in an entirely different way.

This does not mean certain jobs are not naturally so arranged that each pour is more or less a repetition of the last. Some are very much so: most tunnels, for example, and plain slabs, and straight walls. Nor does it mean there is anything obscure or complicated about the Pumpcrete system. Jobs are individual. Forms are individual. Working conditions change with locale, climate and organizations.

Simplicity has been the keynote of the Pumpcrete's success. Operations should be kept as simple as conveniently possible. At the same time slightly more elaborate rigging methods or devices for distribution will often make an appreciable difference in overall placing costs.

The factors governing pipeline setup, or placing methods are: Available equipment and facilities for rigging, type of structure, location and size of pours, specifications, etc. Some of the methods illustrated in this chapter require mechanized equipment for installation and are only justified on extensive mass placement. Others are so elementary as to be contrived with a small crew and no machinery. The latter are applicable to any size or type of work where their use will effect placing economy. Reductions of operating expenses which may be gained through taking advantage of job opportunities are all to the good for any organization.

In the following remarks and illustrations it will be understood the classifications as to types of pours must necessarily be applied in the broad sense due to the infinite variety of structures and requisites. As with other operations, some organizations "will go to town" on a layout perhaps totally unsuited to the talents or policies of others. Methods must be determined individually to meet controlling job factors.

Slabs

With the exception of ordinary highway and street paving and relatively narrow, low structures such as docks, footings, beach-walks, etc., which are readily accessible to truck mixers or pavers, no method yet devised approaches the Pumpcrete for all around efficiency and economy on general slab work. Many designs from 3 in. to 9 ft. in thickness and comprising up to several thousand cubic yard monoliths, placed under a host of conditions, have established this fact.

In the most common procedure, the pipeline is supported on saw-horses or "X" frame staging of varying height (depending upon width of slab) set up under each 10 ft. pipe section, approximately along the center line of the pour. The concrete is distributed by means of a swivel spout swung from a roller hanger on the discharge pipe. Spouts designed for this purpose are supplied by Chain Belt Company in standard 10 ft. lengths. See page 91. These spouts can be adapted to meet special requirements or other types may be substituted. The saw-horses, at slightly more initial expense, are usually preferable to "X" frames in that they may be used over and over, can be extended or shortened, are more easily shifted and can be handled by labor in all localities. As a rule carpenters are required to set "X" frames.

Widths up to 50 ft. can be covered in this manner by raising the line and either increasing the spout length or by pouring into auxiliary chutes which are shifted as occasion demands. However, the operation is generally more efficient if the strip can be confined to the normal chuting limit of a standard spout; particularly in the case of wide slab areas, poured in continuous strips where the horses and pipe are to be rehandled.

The number of men required for top progress will depend on: size of pump (i. e., volume per hour), width and depth of slab, type of vibration, space for disposing of pipe and horses, whether or not pipe is to be relaid for another strip, finishing requirements and other factors. Obviously, a wide, thin section placed at the same rate of progress will require more labor per cu. yd. to place than a heavy section where there is time for the puddlers to handle other duties.

Slabs poured from horses may be roughly divided into two classes: wide area slabs that are poured continuously in a series of strips, and those poured from one setup, either in their entirety or between construction joints.

In the former, the width of the strip, consequently the spout length and height of the pipeline, is regulated by the length of the pour and the time element involved in getting back to keep the edge alive. If the section is fairly heavy, and it is convenient to setup for 5 to 10 ft. strips, no spouting will be required. The pipe can be set up on blocks or very low horses and swung from side to side to reduce puddling labor.

In all instances where horses or blocks are used, the pour is started on the far end of the line and moves back toward the pump; thus avoiding setting over freshly placed concrete as well as realizing greater production from the pump. (Note—Exceptions at end of "Slabs"). When using the gated spout shown on page 91, the gates are opened as required to minimize spreading labor. It is desirable to start working on one side at the outside limit of the section (pouring from the extreme end of the spout first), swinging in a semicircle to the opposite side. A free space should be left around the end of the pipe and last horse to provide a place for concrete when the spout is removed. When it is time to move, the chute is rolled from under the discharge pipe, emptied

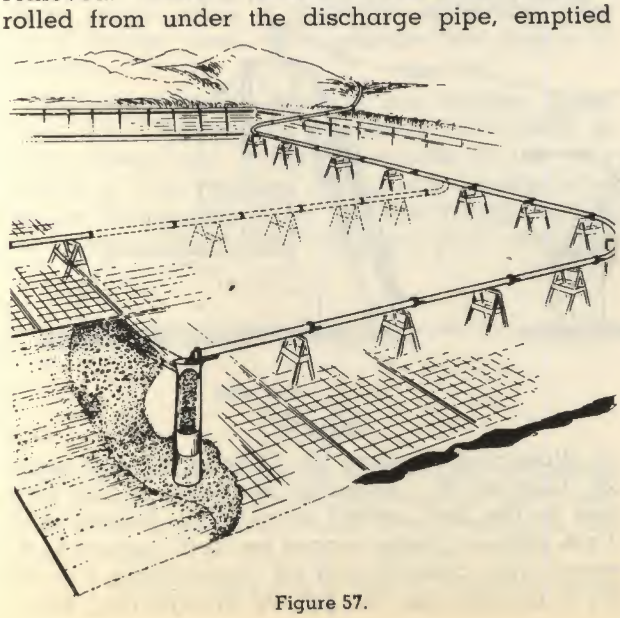


Figure 57.

Figure 58.

and transferred to the next outlet; usually two pipes back, on wide strips. The pipe is disconnected without stopping the pump and removed, along with the horses. It is then swabbed or hosed out. If another line is to be placed, the pipes are set up in the next bay by part of the puddling crew (with the larger machines an additional man or two will be required for this operation on thin sections).

Figure 57 illustrates the proper manner of using the gate type spout and the method of removing pipe and horses to an adjoining strip or bay as the pour progresses. The pump is stopped only for changing the 90 degree ell from one lateral pipeline to the next.

Figure 58 represents a heavy section laid in narrow adjoining strips.

The average distributing and finishing crew required for full production on general slab work follows: Pipeline on shoulder high horses.*

Single Pumps	*15 to 33 Cu. Yds. Per Hour*
1 Vibrator	Rigid specifications sometimes call for one 1-man vibrator for each 10 cu. yds. per hour.
3 Puddlers	Handle pipe and chute.
1 Finisher 1 Helper	Depending upon area and degree of finish required, more finishers required with wide thin slab.
1 Foreman	
Total Crew—7 Men	
Double Pumps	*50 to 65 Cu. Yds. Per Hour*
2 Vibrators	
4 Puddlers	(More with wide thin slab.)
1 Pipe Man	
2 Finishers	(Depending on conditions.)
1 Finisher Helper	
1 Foreman	
Total Crew—11 Men	

*Appreciably higher saw-horses, because of the greater difficulty in moving, will increase the above crews by one or two men.

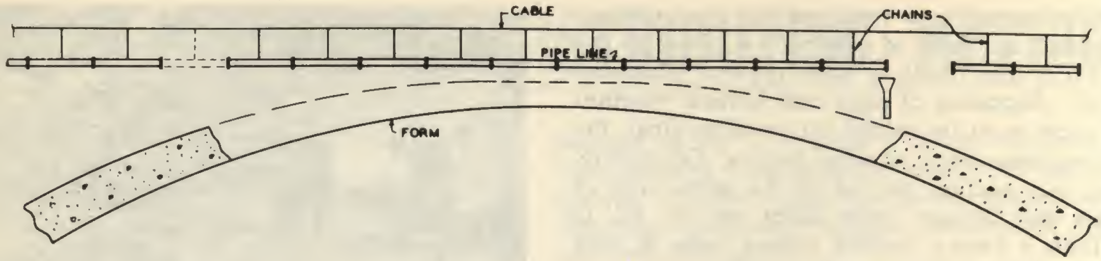
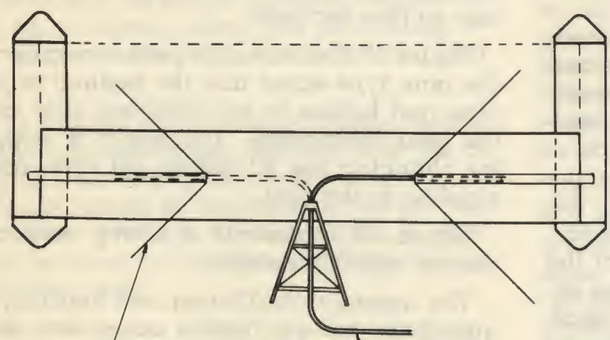


Figure 59 shows a pipeline suspended from a cable for even distribution on a large arch form. The method of rigging pipe for cable support is outlined on page 58.

Previously noted exceptions for working toward the pump in pouring slab: Where the pipe is supported by other means than horses such as beams spanning a form, hooks from overhead beams as in buildings and pipeline supported by a cat-walk or cable, the pour may progress away from the pump if it is desirable.

Sometimes when another form will be ready beyond the first pour, it will be economical to pour away from the pump adding pipe as required, then hooking directly into the next pipeline when the pour is completed.

In certain types of forms where a balanced load is essential, as in large arches, provision must be made for alternate pouring from either end, converging in the center. This may be accomplished by a number of methods, where conditions are unfavorable for setting directly over the form with a parallel pipeline as in Figure 10 on page 9, or where pipe vibration on the form is excessive. Figures 59 and 60, with variations, are suggested as alternates.



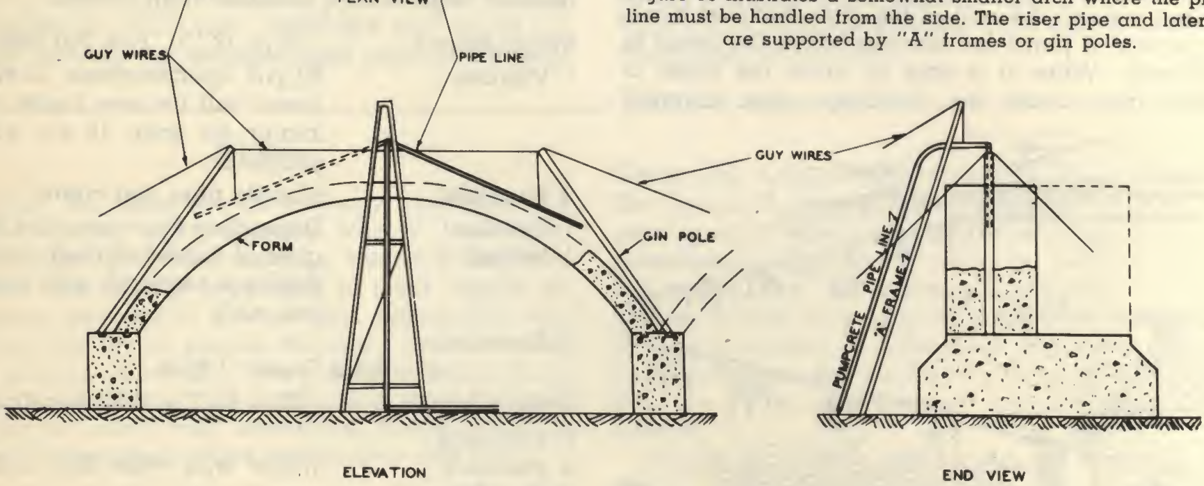


Figure 60 illustrates a somewhat smaller arch where the pipeline must be handled from the side. The riser pipe and laterals are supported by "A" frames or gin poles.

Footings and Columns

It has been difficult to convince even experienced operators at times that the Pumpcrete can be used economically on small, scattered footings and columns; yet it has been done time and again as illustrated on page 59, Chapter IV, and page 25, Chapter III. Attention is drawn to the fact that in the first named setup 6 yd. footing and 3 yd. column pours, spaced on 25 ft. centers both ways, were concreted at an approximate cost of 0.4 man-hours per cu. yd. for transporting, plac-

ing, finishing and handling pipe between pours. (To arrive at this figure the Pumpcrete operator and oiler are added to the listed crew of 7 men placing 30 to 35 cu. yds. per hour. 0.10 man-hours per yd. is allowed for pipe handling between pours.) In the second example, Bodin & Son list a crew of 6 men averaging 14 to 15 cu. yds. per hour on the footings and roof columns, 24" diameter, shown in Figure 36 on page 26; 75% efficiency with a Model 160. Allowing .07 for extra pipe handling between pours, this setup shows a cost of approximately 0.5 man-hours per cu. yd. for transporting, placing and finishing.

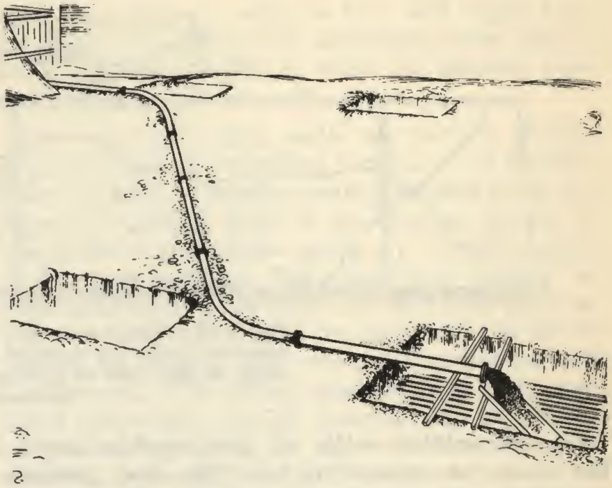


Figure 62—Small multiple footings poured directly from the pipeline.

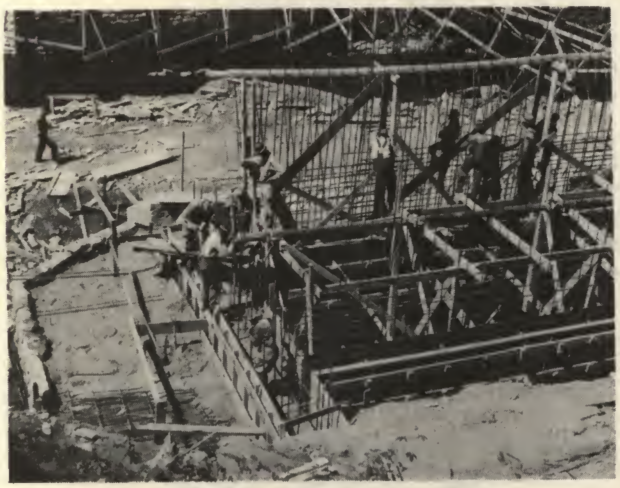


Figure 61—Full production with four puddlers and a foreman while the steel gang put the finishing touches on reinforcing for next pour.

On many occasions the Pumpcrete owner will owe himself money if he fails to take advantage of circumstances which may combine to make these small pours a profitable operation. (For small bridge piers and columns, see pages 10 and 13.)

Somewhat larger footings are another story; right down the groove and plain to be seen in most cases; often difficult of access by the very nature of their purpose, such pours are relegated to the commonplace by pipeline transportation. As illustrated in the accompanying sketches, where not readily accessible to Truck-Mixers, Pavers, etc., all that is necessary for economical placement is to set up the pipeline, hang the spouts, start the plant and grind away.

Figure 63—24" foundation 50 ft. wide, built in coffer dam at bottom of a 300 ft., 18 degree slope impossible to navigate with trucks. 240 cu. yds. placed in 12 hours by Model 160 without stopping the pump—Sewage Treatment Plant, Highwood, Illinois.

Walls

Circular walls of almost any section and diameter present no particular difficulty and may generally be handled by one of the methods discussed under the heading, "Circular Tanks."

To a degree the same is true of square or regularly shaped wall designs. Heavy sections where sizeable quantities are involved can be placed economically in most cases with one of the rigging devices outlined later on in this chapter. Thin sections of regular shapes can also be effectively handled by one of several methods provided their area is not too large.

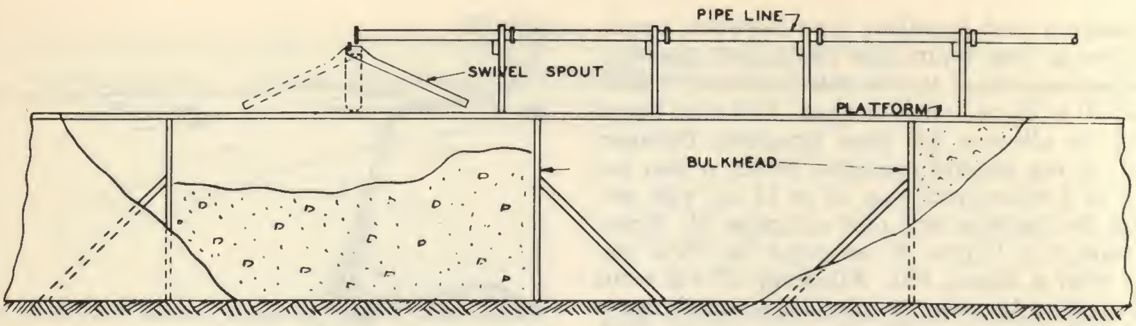


Figure 64—Method of pouring wall in alternate sections where expansion joints are specified at fairly close intervals. Pouring starts on short end so pipeline will be in place for remaining sections next day.

Thin Monolithic walls of considerable length that must be raised in low lifts and poured through tremies can be a headache. Sometimes (and particularly where inserts are numerous, or where the wall forms a large enclosure) it will be economical to set up a floor hopper and buggy the pour. The chief advantage in this arrangement with the Pumpcrete lies in providing a continuous flow of concrete to a hopper or hoppers that may be spotted in central locations to cut down wheeling distances and in the elimination of hoisting equipment. If long walls are reasonably straight, as in spillways, retaining walls, sewage treatment plants and large area buildings, with few or no inserts, they can usually be poured at a lower cost directly from the pipeline. The Chain Belt Company has developed gate sections applicable to this type of work but they are not recommended for ordinary conditions. It is usually just as convenient to disconnect pipe sections at intervals for discharging into the form. Where construction joints are specified at close intervals in long, thin walls, the problem is simple, as illustrated in Figure 64.

Building walls are generally poured either by spouting from a suspended pipeline which will remain set up for slab or from a line set on horses at the top floor level which would approximate the setup in Figure 67, as two walls can often be reached from one spouting point. In the event of considerable concrete poured into double walls, two spouts should be used to avoid the delays in moving from wall to wall, as well as from location to location.

On isolated walls where it is necessary to provide high pipe supports, the most economical setup is 2" x 6" scabbing attached to the form under the center of each 10 ft. length.

It will be necessary to stop the pump every time pipe is added to the line; so the fastest arrangement is to start on the far end, dump each pipe directly into the form as it is removed from the line, recouple the empty pipes together in sections of several lengths and roll it to one side.

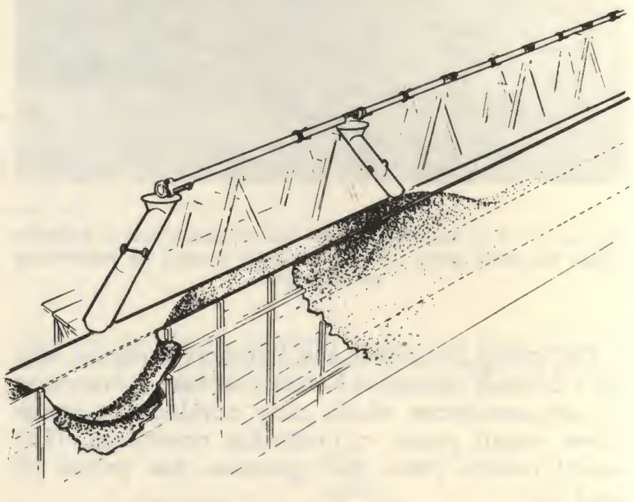


Figure 65—High thin wall placed in lifts with gate sections and roller spouts. The pour may start at either end of the form. When a gate is closed, the pump is started for a few strokes before the next gate is opened. As a gate is only opened for a few moments on such work, this procedure will keep the concrete alive in that part of the line beyond the point of discharge. Provision is made for this operation by short-potting the far end of the form enough to provide the necessary space. The pour is also usually finished on this end of the form in order to wash out the entire line.

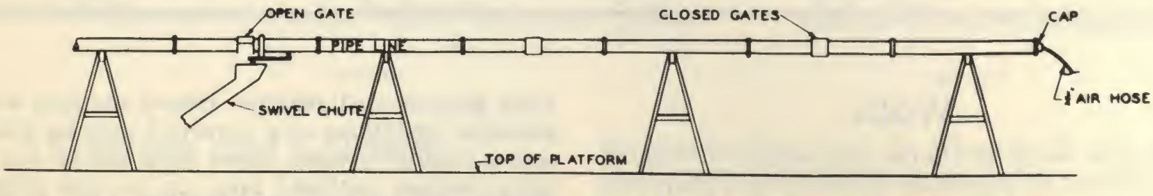


Figure 66—Alternate method of cleaning pipeline with air where gate sections are used on a long wall poured in lifts. A tight roll of wet sacks is inserted into the far end of the line; when the pour starts progressing back or returns to the opposite end of the form, the inert concrete is either blown out altogether or partially blown at intervals to avoid setting action in the pipe.

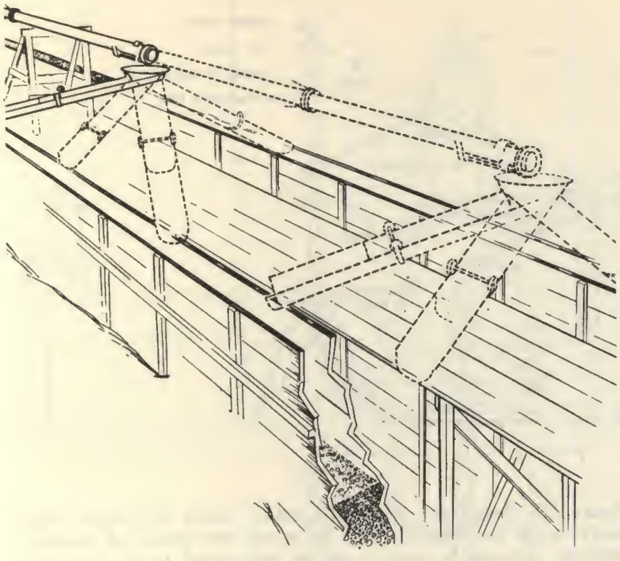


Figure 67—Pipeline setup on scaffolding between two walls.

When the end of the form is reached, one of these sections is hooked back on the line and the pump started until concrete is pumped through the dry pipe, then the next section is added and so on back to the starting point. (An air dome will largely eliminate all vibration in the pipeline.) Where concrete is discharged into tremie spouts on the lower lifts and internal vibrators are used, a good crew of 7 men can maintain around 75% efficiency with the smaller Pumpcrete; 2 men to move tremie spouts, 2 men to handle one vibrator (one more man for each additional vibrator), and 3 men to handle the pipe. Where tremie spouts are not required in the form, two men will be dropped from this crew.

Where the height is not too great and two walls can be reached from one setup, it will sometimes be advantageous to scaffold between the two, as shown in Figure 67. Balancing the cost of this setup against the cost of setting single lines over the two walls in turn will depend on the height, how often the scaffolding sets can be used, and the length of carry in moving pipe and lumber.

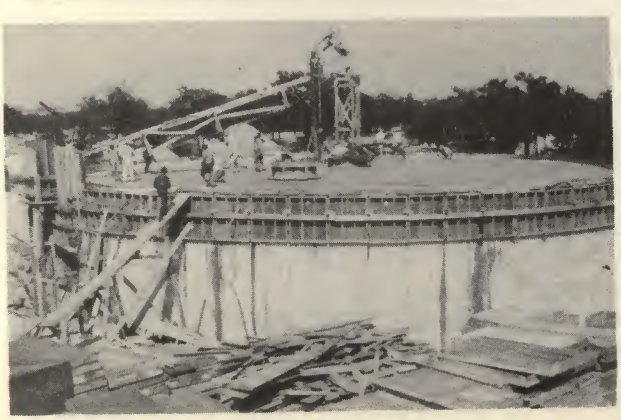


Figure 68—Merry-go-round distributing chute devised by the Permanent Construction Co., for pouring 90 ft. diameter tanks on Sewage Disposal Plant.

Low, relatively thick walls are usually poured in one lift with the pipeline carried on or directly over the form. The pour may progress from the pump by adding pipe to the line as shown in Figure 69 or toward the pump by removing pipe as the form is filled. The latter may require an additional man in the crew for swabbing pipe as it is removed but unless the pipeline will be in position for another pour when the former method is employed, it is usually preferable in that maximum production can be maintained. As stated heretofore, pipe can be removed from the line while the pump is working. Experience has shown that thin high walls can quite often be poured to greater structural as well as economical advantage by the same method (i. e., in one lift) if the form is substantial enough to take the load. Where the time element is tight in making a low-lift sweep, cold joints, honey comb and water marks will be eliminated and the reinforcing does not become spattered, as it will in the ribbon method unless unusual precautions are taken. Some engineering organizations have ruled very little segregation can take place in the narrow confines of a thin wall provided the concrete is a good workable mix of the proper consistency.

Several methods for pouring heavy wall sections between construction joints will be found under the heading, "Miscellaneous Methods."

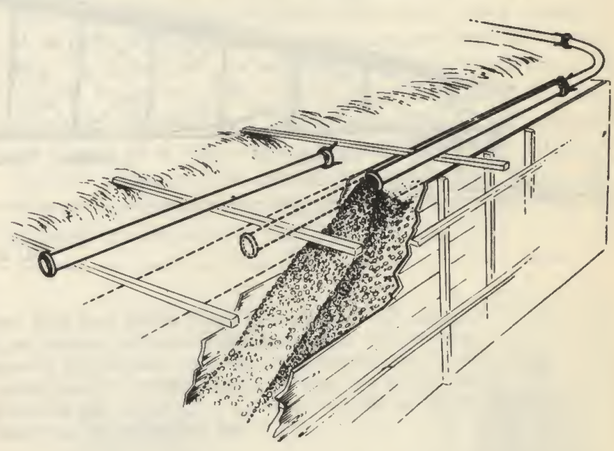


Figure 69—Pipeline setup on form for low, relatively thick wall placed in one lift.

Circular Tanks

Circular structures are made to order for the Pumpcrete, insofar as distribution is concerned. Small tanks, i. e., up to 50 or 60 ft. in diameter, can usually be rigged for continuous pouring by one of several methods shown elsewhere (Figure 34 and Figure 79). Larger tanks can also be prof-

itably rigged for continuous pumping provided the volume of concrete to be placed will offset the expenditure for special distributing devices.

The merry-go-round chute in Figure 68 was constructed at an overall cost of $170 for material and labor. It was dismantled, moved from tank to tank progressively and erected with the pipelines in place at a labor cost of from 25 to 35 man-hours per move and distributed from 200 to 600 yds. of concrete at each setup.

By its use, continuous full speed operation was maintained on two 160 Pumps with a distributing crew of 5 men, exclusive of finishers. These wall pours were the lowest cost concrete on the project.

The quantity of concrete involved to make a device of this nature practical from the economic standpoint will depend largely on the accessibility of the structures, etc., as well as the direct placing cost. Under almost any circumstances 2 or 3 thousand yards of concrete would make such rigging a paying proposition.

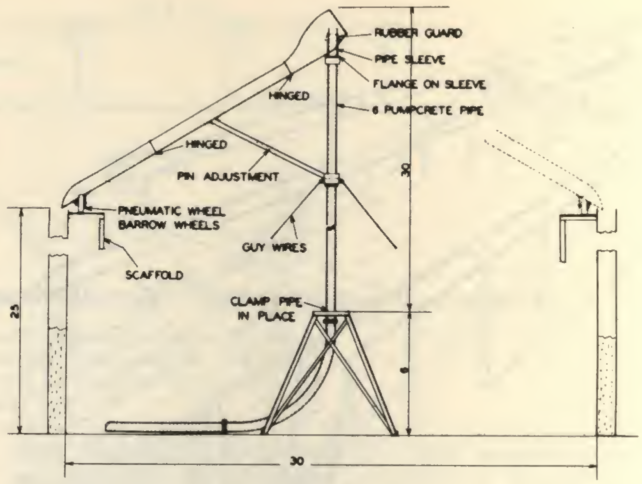


Figure 70—Setup for relatively small tanks or inside tank pours, such as hopper rings in grain elevators. A special rotating, adjustable spout can be fabricated to fit over the discharge end of the pipeline riser, which is guyed off and serves the purpose of a gin pole support.

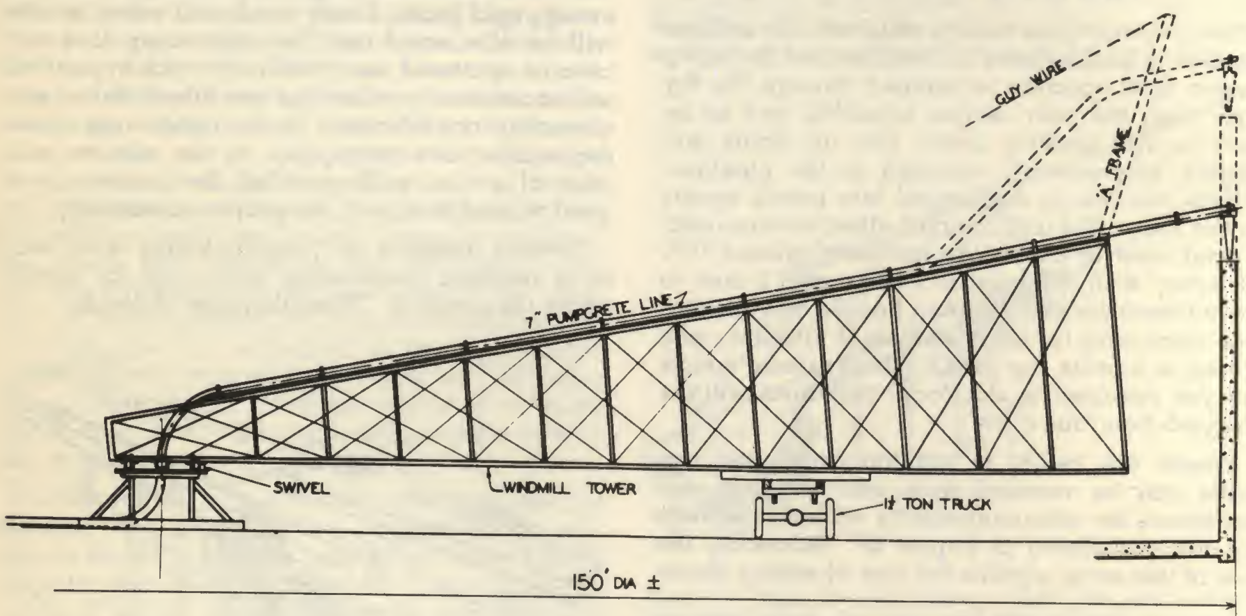


Figure 71—Standard windmill tower and REX swivel distributor adapted to large area monolithic tank pours. Bottom concrete can be poured by the usual wide area slab method or by moving the truck outside the tank and distributing through tremie spouts, provided the swivel stand can be boxed out and the time element in completing a round on the outside limits is not prohibitive. Walls in heights up to 20 or 25 ft. can be handled economically with this device, where a number of tanks are involved to absorb the initial rigging expense.

Miscellaneous Methods and Devices

Although some of the methods and devices in the following sketches and pictures are more or less standardized for certain types of work, the present purpose is to illustrate the adaptability of the pipeline setup to almost any situation which may be encountered, rather than to make recommendations for specific problems.

The quantity of concrete involved is of course a major controlling factor where such methods or devices are concerned. Another factor is the available equipment on the job for handling or rigging the setup. Sometimes machines or ma-

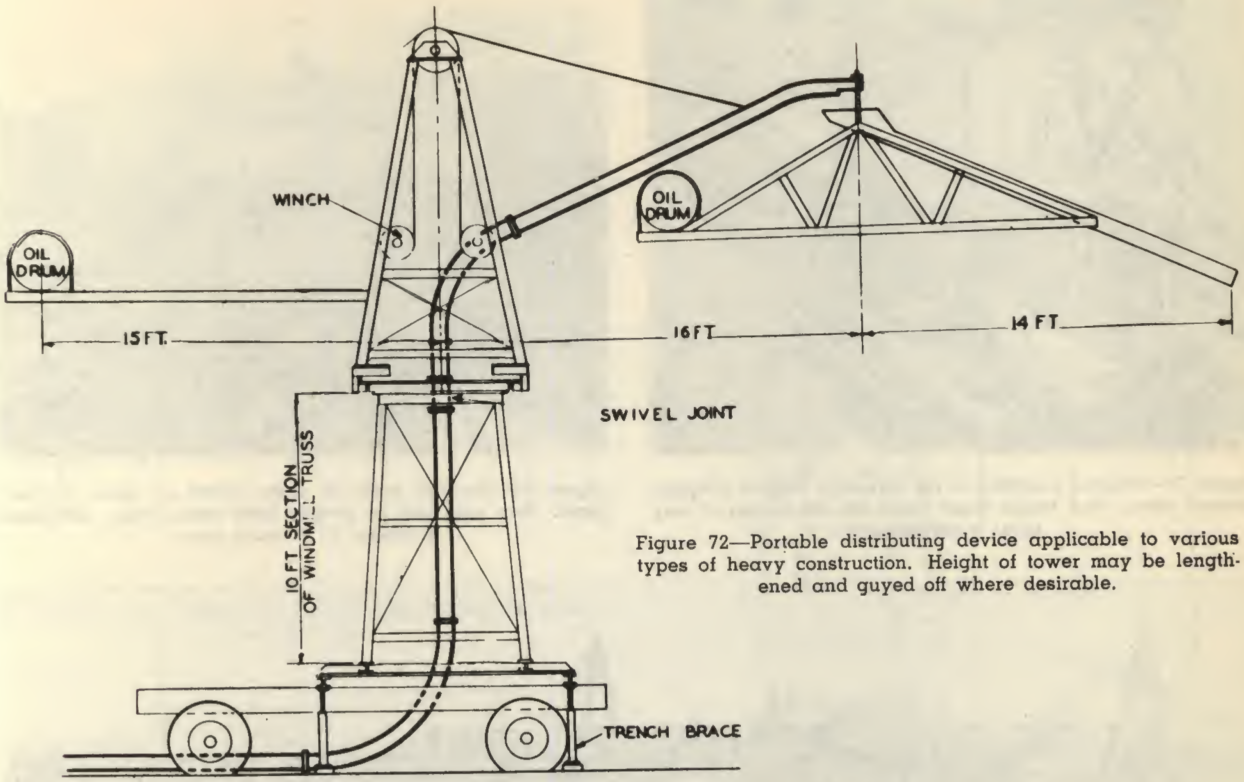


Figure 72—Portable distributing device applicable to various types of heavy construction. Height of tower may be lengthened and guyed off where desirable.

terials already in a contractor's possession may be readily utilized whereas their purchase for the particular purpose would be poor economy. An example of this point is shown in Figures 87 and 88.

It boils down to a problem of balancing labor savings either in the number of men required for distribution by ordinary methods, or in increased production against the initial expense and handling costs of appurtenant equipment.

The more elaborate devices are designed for mass concrete only, and where facilities for rigging would be at hand as a matter of course. "A" frames, gin poles, jumbo derricks, cables, etc., of moderate size do not require machinery for portability or quick economical erection.

The standard "A" frame setup may be applied to many types of work, with or without spouts or tremies. Simple of construction and easy to erect, it is probably the most common method of elevating a pipeline for continuous distribution into fairly large forms. The frame in Figure 76 was constructed and set up with the pipe and spouts in place at a total labor cost of less than 10 man-hours. Where it is necessary to extend some distance out to cover a larger area, the pipe can be rigged as shown in Figures 73 and 78.

Figure 73—Gin pole supporting riser pipe at an angle of 45 degrees high enough to discharge into multiple coal chutes on mass pour.

Figure 74—Pouring bridge pedestals with the second riser pipe in place for a quick change.

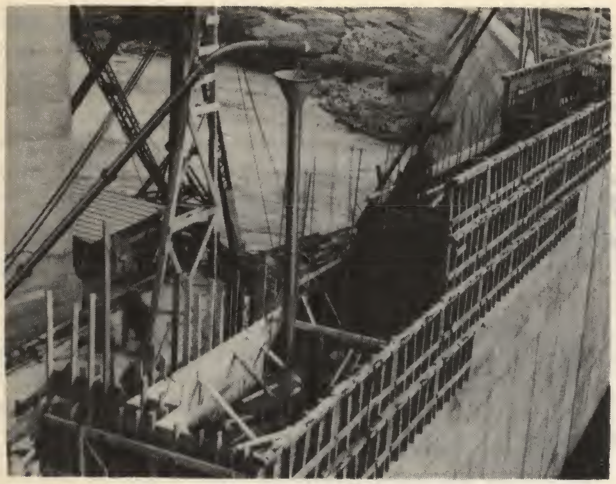


Figure 75—Pouring a section in the diversion wall of a hydroelectric plant. The single trunk spout can be swung to any point in the forms.

Figure 76—Pouring walls of pump house on small disposal plant. Roof slab will be poured from same setup. One man to handle 10 ft. roller spout.

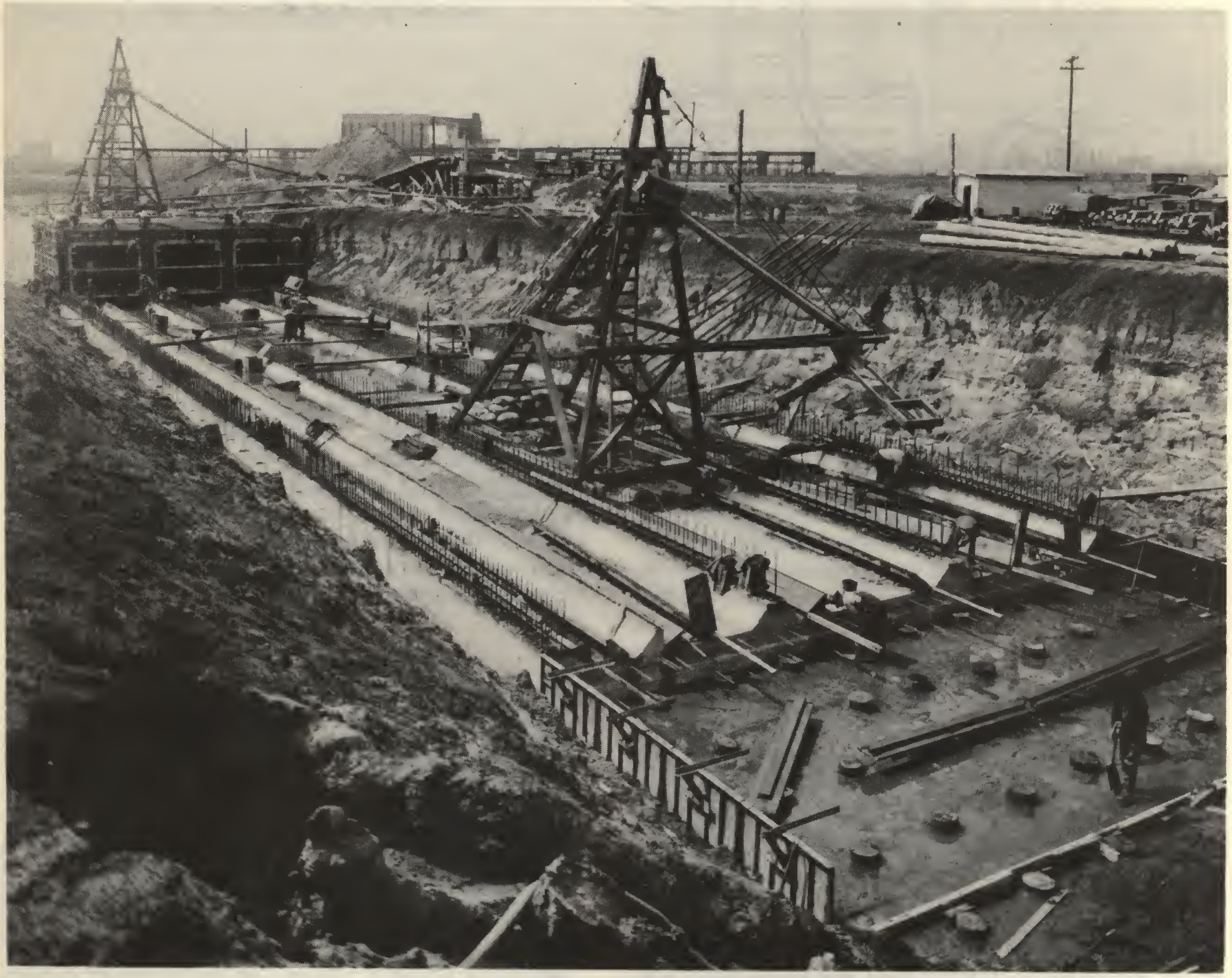


Figure 77—The G. L. Tarlton Company of St. Louis devised these movable jumbo derricks as pipeline carriers and distributing towers on the 3 barrel box conduit of the Cahokia Creek Diversion and East St. Louis Drainage project. One derrick was moved along the bottom, the other on top for pouring the sidewalls and roof slab. Two pipelines ran from a Double Pumpcrete; one to each derrick. By alternating pours between the two as a section was filled, continuous pumping was maintained on concrete shifts. The pipe risers ran up 45 degree ladders discharging into a chute hopper. Concrete was distributed by means of one fixed chute leading into an adjustable counterbalanced swivel chute.

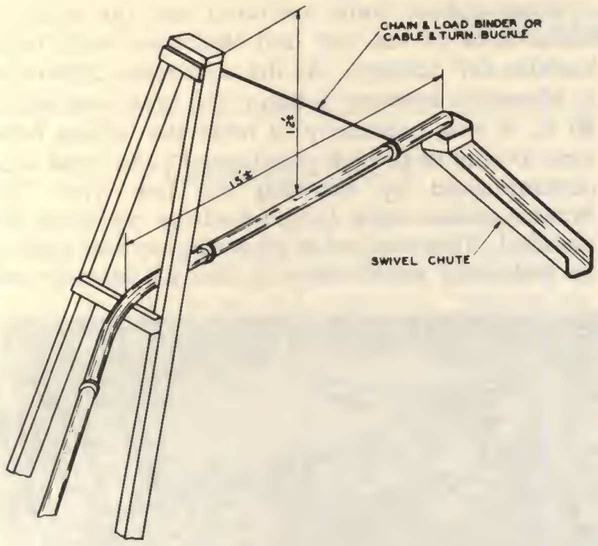


Figure 78—Variation of Figure 76, where a larger area is to be covered. "A" frame is extended high enough to support extended pipe.

Figure 79 — Spindle tower hopper with fixed and counterbalanced chutes designed by Frazier-Davis Company. The spindle, of adjustable height, is guyed four ways and rotates 360 degrees in either direction. As indicated in the photograph, this setup requires a top flight rigging crew. Note how 45 ft. of riser pipe is swung into place over the chute hopper from one of the guy lines.

Properly handled, this device will facilitate production and economic placement on many types of large pours. Continuous full-speed pumping can be maintained on wall sections of any shape (within the practical area limit) with a very small crew: two laborers to handle the chute plus the number of vibrator men required by the specifications, or sound practice, plus the number of men required to handle tremie spouts where they are required in the form.

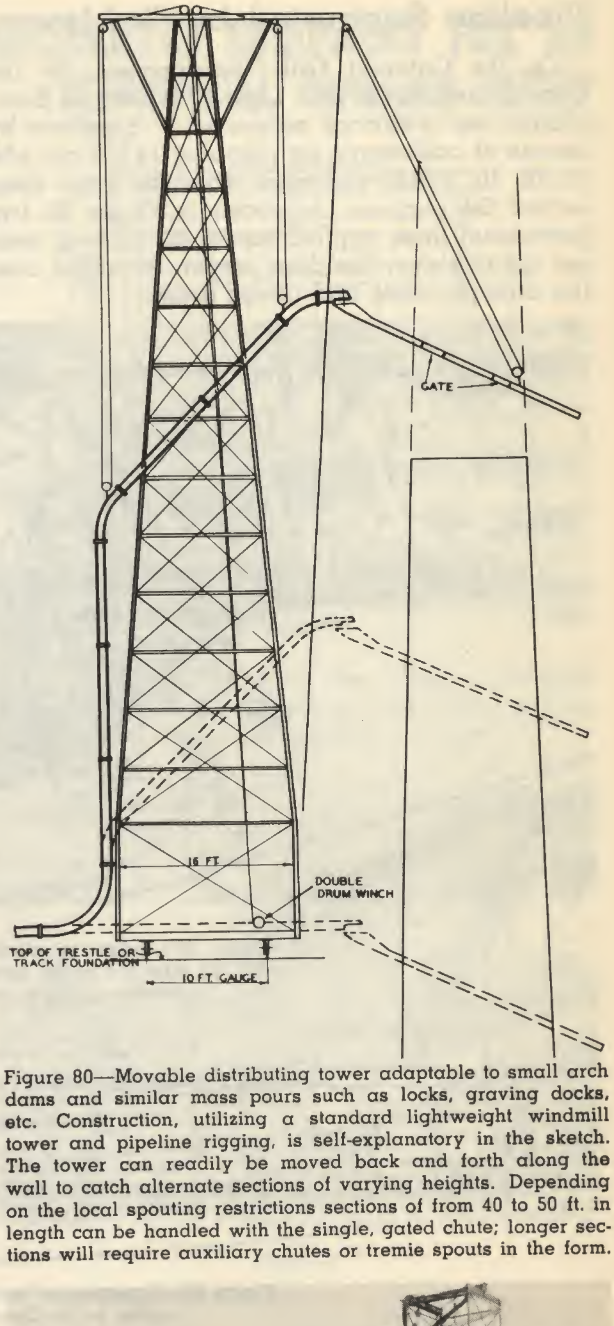


Figure 80—Movable distributing tower adaptable to small arch dams and similar mass pours such as locks, graving docks, etc. Construction, utilizing a standard lightweight windmill tower and pipeline rigging, is self-explanatory in the sketch. The tower can readily be moved back and forth along the wall to catch alternate sections of varying heights. Depending on the local spouting restrictions sections of from 40 to 50 ft. in length can be handled with the single, gated chute; longer sections will require auxiliary chutes or tremie spouts in the form.

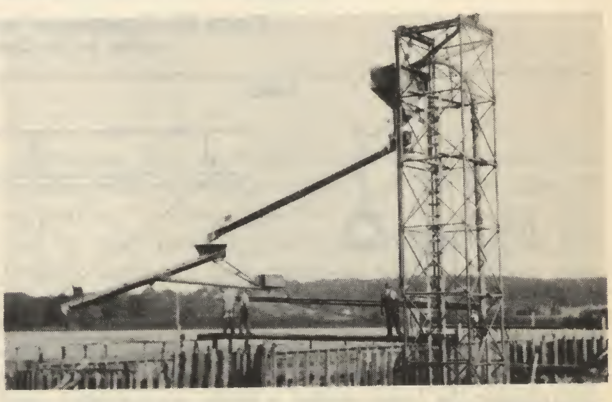


Figure 81 — Distributing tower used for mass placement on Muscatine Dam by the Central Engineering Company of Davenport, Iowa.

Pipeline Supported by Cableway

On the Cataract Falls Development, for the Cumberland Power and Light Company at Saco, Maine, the contractor supported 7" pipelines by means of cableways for pumping 14,000 cu. yds. 80,000 lb. cable salvaged from the junk heap served the purpose. As shown in Figure 82, two permanent lines approximately 450 ft. long were set up; one over the dam proper, the other over the draught tubes and power house.

These cables were anchored into the rock on either side of the cut and tightened with turnbuckles (36" takeup). As the maximum difference in elevation between footing and crest was some 80 ft., it was necessary to raise the cables from time to time as the job progressed. The raise was accomplished by drawing the line over "A" frames which were lengthened as occasion demanded. This method of pipe rigging was said to be eminently satisfactory for the job in question.

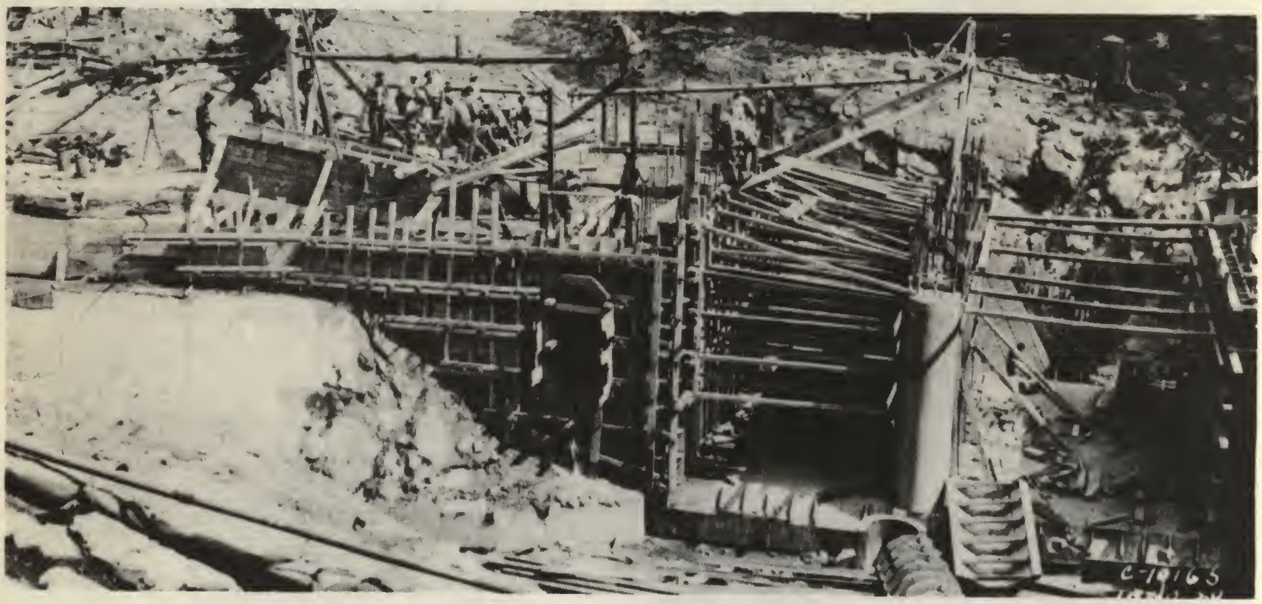


Figure 82—Cableway elevated by "A" frame. Cable over draught tube and power house comes straight off of Pumpcrete under building at extreme left side of picture.

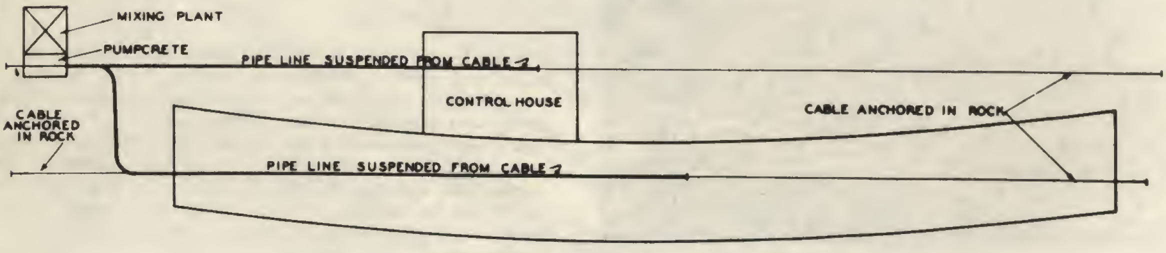


Figure 83—Approximate location of Mixing Plant and pipeline cables on the Cataract Falls Development.

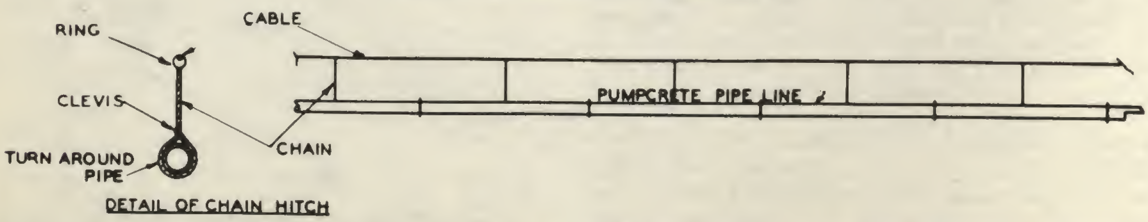


Figure 84—Method of rigging pipeline on a cableway setup. The pipe may be attached to the cable by short chain loops with a turn around the pipe or by short pieces of lighter cable and clamps; the former makes a faster, more flexible setup. When hanging for the first time, pipe sections are coupled on at one end and pushed out. When the line is too long to be pulled out with a rope block, a small tugger will serve the purpose. If the line is supported about 2 ft. beneath the cable, it is a simple matter for a rigger to skin out on the pipe to uncouple a section for pouring into any desired location, lower or raise tremie spouts, etc. On relatively low lines ladders can be used for the purpose of breaking pipe and hanging spouts.

UTILIZING INCIDENTAL EQUIPMENT FOR AN ECONOMICAL PIPELINE SETUP

Example No. 1

Two 35 ft. x 100 ft. open well caissons, 40 ft. apart raised in 10 ft. lifts and settled by jetting. Dug by stiff leg derricks at either end and on center line between the caissons. Reinforcing steel projecting above the forms caused considerable difficulty in making a pipeline setup for full production from the Pumpcrete. The problem was solved by erecting 38 ft. fixed towers at the ends of each caisson to carry a steel truss the organization had fabricated for some other purpose and still had on hand. The riser on two towers and distributing pipe on the truss remained in place at all times so it was only a matter of 15 minutes in hooking up for a pour. When not in use, the truss sat to one side, out of the way, as shown on the sketch. When a pour was ready, the two derricks snatched the truss into place on the towers, the top 90 degree ell was coupled onto the riser pipe and a 750 yd. pour could be deposited without stopping the pump. Concrete was distributed by means of coal chutes shifted around as occasion demanded.

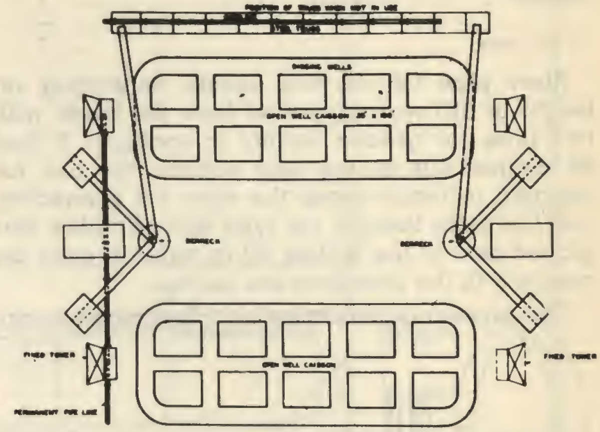


Figure 86.

Figure 85.

Figure 87.

Example No. 2

A Double Pumpcrete was installed on a large industrial plant contract involving about 100,000 cu. yds. of concrete. Some 5000 yds. were in widely scattered footings and piers. The piers were approximately 20 ft. high, required 6 yds. of concrete to be poured in two lifts, after 6 yds. were placed in the footings, and were spaced on about 25 ft. centers. Ordinarily a tower paver, crane-and-bucket, or some such method would have been used on these pours.

However, this contractor had an old back-filler standing idle on the location and got the idea of supporting a riser pipe from its boom and running up and down beside a pipeline strung on the ground between two rows of piers; cutting into the line at convenient points, as illustrated in Figure 88.

After the first pour or two, a crew of 7 men was able to place concrete at the rate of 30 to 35 yds. per hour. After a form was filled, it took less than 5 minutes to move to the next location and get the pump running again.

Distributing Crew Required for This Operation

	No. of Men
Operator on back filler	1
Laborers on vibrator, distribution and pipe changes	4
Finisher	1
Foreman	1
Total crew	7

Riser pipe (of varying length depending on height of lift) was supported from the boom with two lines for greater facility in spotting. It had 45 degree ells at top and bottom; the one for hanging a tremie spout, the other for connecting into the main line. A pin type shut-off valve was placed next to the bottom ell in order to save the concrete in the riser between moves.

The procedure was to set up a line between two rows of piers, and break it at each place where the riser was to be cut in. Pouring started on the end closest to the pump. When a form was filled on one side, the riser was cut loose and swung to the opposite pier; after this form was filled, the riser was again cut loose and the back filler moved down to the next location. As stated previously, less than 5 minutes were required to make a move and start pumping again in the next form. At the end of a row, the line was go-deviled out (cleaned by the go-devil) and remained in place for the next lift.

Variations of this setup have proved successful under similar conditions, by substituting a tractor for the backfiller and rigging it with an improvised timber boom or mounted "A" frame for supporting the riser pipe.

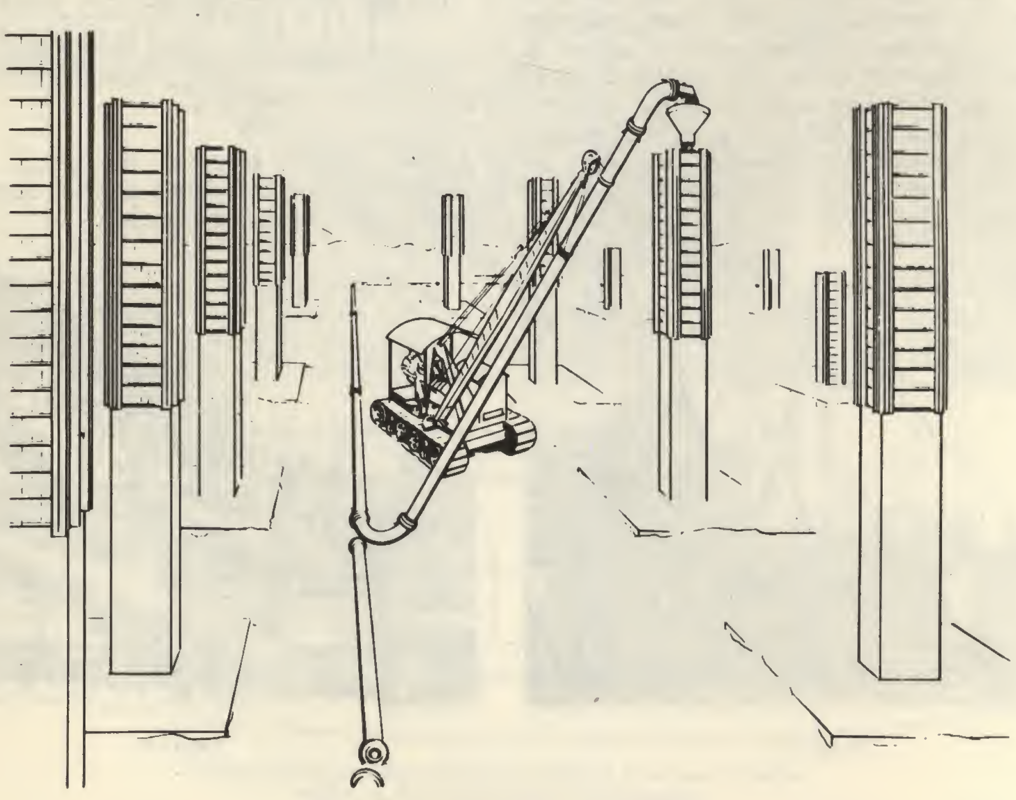


Figure 88.

Tunnels

Per cubic yard labor for direct placing will be appreciably lower with Pumpcrete than by other methods on the large majority of applications; particularly where the pump is set up outside the tunnel and serves both as transporting and placing equipment. In addition, other important savings may be gained through utilizing the pump's greater flexibility and longer placing range. These savings will vary with changing conditions but they are generally there for the taking in one form or another.

Tunnel lining methods are outlined in another bulletin, "Tunnel Lining with the REX Pumpcrete." The following example is shown as typical of the Model 160 setup on a small tunnel worked under compressed air.

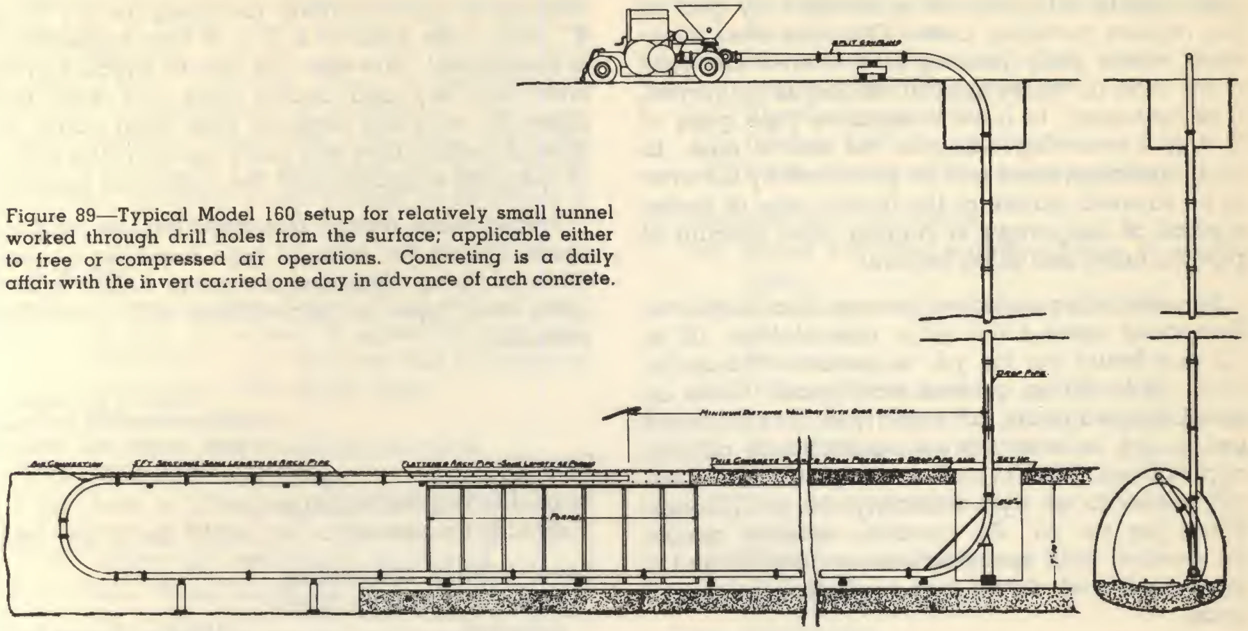


Figure 89—Typical Model 160 setup for relatively small tunnel worked through drill holes from the surface; applicable either to free or compressed air operations. Concreting is a daily affair with the invert carried one day in advance of arch concrete.

In this particular case closely spaced reinforcing steel enforces the use of a one-piece, flattened arch pipe. Such design favors the use of one long pipe with 5 ft. sections to be removed outside the form, as the slick is withdrawn. However, in those localities where ground conditions make it expedient to pour arch and invert together, against a closed heading, the "goose neck" can be moved back to the form as shown in Figure 52 and a special arch pipe made up of short sections worked out for removal from the discharge end of the line as the form is filled.

Concrete Procedure (Compressed Air Tunnel)

Pipe is capped on surface until pipe is set up into form. Line is then parted at bottom of 180 degree bend and covered with board or cap while the pipe is coupled together on top. Pumping starts and when the pressure becomes equalized in the pipeline, the board will drop off. The 180 degree ell can be recoupled before concrete reaches the break so that pumping is not stopped until it is time to remove a 5 ft. section from the line. The arch pipe can be shifted from side to side to keep the form balanced. When the key is packed up close to the discharge end of the pipe, pumping is halted a moment; the line is blown out, a 5 ft. section removed, the arch pipe drawn back and recoupled and pumping resumed. The process is repeated until the form is full. Then the arch pipe and ell are blown out and removed while pumping continues on the invert. The average rate of progress with a Model 160 on tunnels of this nature is 12 to 15 cu. yds. per hour including delays for removing pipe and cleaning the line at the end of a pour. The line is generally blown out with compressed air to avoid water in the hole.

The average crew for handling two headings on a setup of this nature on small tunnels, with ready-mixed or wet-batched concrete, would be as follows:

	No. of Men
Pumpcrete operator	1
Truck driver (part time to move pumps)	1
Labor to clean up on top and dump trucks	1
Vibrator men	2
Form watcher and booster man	1
Utility man	1
Foreman	1
Total concrete crew, from Pumpcrete to final place in forms, 8 hour shift. 30 ft. ± arch and invert can be placed in two headings with this crew	8

Notes on Pipe Handling

Here again the many variables obviate the possibility of setting a definite man-hour cost per yard; even for simple pipeline installations. Where available, pipe handling costs, i. e., the cost for moving, handling and rigging or scaffolding between pours has been shown with job illustrations. Most contractors on jobs where pours are relatively small do not segregate this item from

other incidental labor. It is handled by part of the regular puddling crew. On wide area structures where daily pouring in scattered locations is the rule, or where special rigging is employed, it is customary to have a separate pipe gang of 2, 3 or 4 men, depending on the size of pipe. In such instances, costs will be governed by the area to be covered, nature of the terrain, size of pours, method of supporting or rigging pipe, amount of pipe on hand and other factors.

For estimating purposes, the reports of numerous Pumpcrete users have set a rate of from .02 to .12 man-hours per cu. yd. on general slab work; from .06 to .20 on general wall pours. Costs on small isolated pours run from .15 to .25 man-hours per cu. yd. or even more on particularly difficult applications. The overall average for the usual job seems to be approximately .10 or .12 man-hours per cu. yd. An accurate estimate cannot be reached until specifications are known and a job layout and distribution methods are agreed upon.

The following data, based on field experience, are shown merely as an aid in estimating probable costs for some phases of pipe handling operations. No guarantee can be given or implied with these figures, as job conditions, the variables previously mentioned, and the human element will set the ultimate rates for individual jobs.

Two men can readily carry and handle a 10 ft. length of 6" pipe (133 lbs.)

Three men can readily carry and handle a 10 ft. length of 7" pipe (182 lbs.).

Four men can readily carry and handle a 10 ft. length of 8" pipe (230 lbs.).

The rate at which pipeline can be set up and coupled is approximately the same for 6", 7", or 8" pipe if the ratio of 2, 3 or 4 men respectively is maintained. However, the rate at which a given crew will lay and couple pipe will vary considerably with the distance they must carry, the kind of footing they are carrying over, the nature of the pipe supports, and the caliber of the men.

Taking these factors into consideration, approximate figures for straight pipe handling at moderate carrying distances are given below (size of gang and pipe in accordance with preceding remarks):

Conditions	*Lineal Ft. Per Hour* (That one gang will carry and couple and uncouple and remove pipe)
Level footing, laying pipe directly on ground	150 lin. ft. per hour.
Level footing, mounting pipe on shoulder high supports	100 lin. ft. per hour.
Rough ground, bad footing, difficult pipe supports as in wall pours	75 lin. ft. per hour.

Attention is hereby called to the fact that in 95% of all Pumpcrete applications pipe handling is decidedly of secondary importance. In other words, where pipeline costs are unusually high, access to the forms would usually be a more expensive operation by other methods. Tough pours are simplified by pipeline transportation.

Then again, as was stated earlier in this chapter, more elaborate and expensive rigging methods quite often effect savings in overall placing costs, although the compensation is hidden in a bare statement of rigging expenses.

CHAPTER V OTHER METHODS

Points for Consideration When Comparing Costs of Other Concreting Methods With Pumpcrete

Space does not permit anything near a comprehensive analysis of the several other standard methods of concrete placement with their variations, combinations and infinite equipment ramifications. It is assumed an organization will arrive at the final figure for each type of job by its customary methods of setting up such estimates, then make a comparison with Pumpcrete costs.

In the remarks on specific methods to follow, it is not implied each has not served a purpose in the development of concrete construction. One or two are apparently almost obsolete but most of the listed equipment is still quite active in general work. However, they are all limited from the economic standpoint to definite spheres of activity while the Pumpcrete recognizes no boundary within its mechanical limitations insofar as the type of work is concerned.

In calling attention to the flexibility of Pumpcrete methods in covering such a wide range of practical application, the point must be stressed that in the large majority of cases in all types of work the simple act of placing concrete does not tell the whole story of actual costs. What goes

before and what comes after this single operation in the way of preparation, expense and effect on other operations, rounds out the picture and makes the story complete. Some of the principal points for consideration in making a cost comparison between Pumpcrete and other methods, are as follows: (In all instances the plant setup is of prime importance and should be included in the comparative estimate.)

1—*Buggies:*

(a) When charged directly from ground level mixers, the speed of operation is a consideration, i. e., the time lost in partially discharging the mixer drum.
(b) Wheeling labor.
(c) Building and handling runways.
(d) Moving Mixer setup.
(e) Loss in changing stock piles and in providing runways and operating space where dry batching is employed.

Note: Where buggies are used in connection with any of the following equipment, points (b) and (c) will be an addition to the other operating costs.

2—*Crane and Bucket:*

(a) Chargeoff or rental on crane.
(b) Delays to other operations.
(c) Degree of portability required.
(d) Moving costs.
(e) Range, i. e., accessibility of forms, handling or maneuvering necessary before final placement.
(f) Methods of transporting concrete or aggregates within reach of the crane boom.
(g) Adverse weather restrictions.
(h) Moving mixing plant (where job plant is used).

3—*Tower and Hoist:*

(a) Erection and dismantling where it is used for concrete alone.
(b) Delays to other operations where handling concrete is an auxiliary duty.
(c) Transporting concrete before and after it is hoisted.
(d) Moving on some types of work.
(e) Limited range of economic usefulness.

4—*Tower Chuting System:*

(a) Erection and dismantling.
(b) Rigging costs (a major item on many jobs where pours are scattered).
(c) Additional transportation or method of placing into form.
(d) Location in reference to accessibility without interference to other operations.
(e) Chuting distance and slope limitations covered in specifications.
(f) Bad weather restrictions.
(g) Limited field for application.

5—*Paver Tower:*

(a) Accessibility to forms.
(b) Transporting concrete after it is hoisted.
(c) Chute limitations.
(d) Moving setup (maintaining water lines, possibly heating water, etc.).
(e) Weather restrictions.
(f) Limited field for application.
(g) Road maintenance on some jobs.

6—*Inclined Belt Conveyors:*

(a) Initial cost and salvage value of equipment.
(b) Handling concrete before and after it is elevated.
(c) Maintenance.
(d) Difficulties caused by segregation.
(e) Portability about the job site and location in reference to interference with other operations.
(f) Extremely limited field for future applications.
(g) Weather restrictions.

7—*Horizontal Belt Conveyors:*

(a) Initial cost.
(b) Installation maintenance, rigging and moving.
(c) Limitations for future application.
(d) Problems of distribution.
(e) Weather restrictions.

8—*High Lines:*

(a) Initial expense, cost of erection and salvage value or possibility of future use.
(b) Transporting problems (at the discharge end with fixed towers—at the loading end with gantry lines).
(c) Loss of progress or delays to other phases of the work during concrete operations.
(d) Speed of operation. Sometimes affected by specified limitations on size of buckets, sometimes by difficulty of discharging large masses into forms (in latter event cost of forming may also be affected).
(e) Weather restrictions.

Note: Attention is called to the fact that on certain types of bridges, dams, plants, etc., where cable ways are indispensable for handling reinforcing, forms or masonry, the Pumpcrete can often more than pay for itself by releasing the cable for other duties as well as by cutting placing costs. It is a very rare occasion where concrete can be placed as economically by long span cable buckets as by the Pumpcrete.

9—*Pneumatic Placers:*

Rarely used outside of tunnel lining, ask for "Tunnel Lining with the REX Pumpcrete."

10—*Truck-Mixers, Pavers and Dump Trucks:*

In a class by themselves where they can be discharged directly into the forms, otherwise they are distinguished as a mode of transportation or as mixing plants and combined with the various methods outlined above.

Contractor's Comparison Between Pumpcrete and Crane and Bucket Method of Placement

The following figures on Pumpcrete operation were obtained from a contractor's organization after they had pumped 102,000 yds. of concrete on a large plant project. The estimate on crane and bucket operation to which they are compared is based on their previous experience under similar conditions.

It will be noted that Pumpcrete rates are set on average production of 50 cu. yds. but will exceed this rate at times to maintain the average. The pavers and crane and bucket are set at 60 cu. yds. per hour although it is improbable that this average could be held.

The cost differential is shown on actual working operations from car to form, including charge-off on equipment. Distribution labor was assumed to be approximately the same. Incidental labor such as lost time, moving equipment, etc., is not included though it would show in favor of the Pumpcrete.

Pumpcrete Cost From Car to Forms (102,000 Cu. Yds.)

Pump averaged 50 cu. yds. per hour.

1. Mixing Cost:

	Per Cu. Yd.
1—Mixer man @ $1.50 per hour	$.03
6—Cement men @ $.60 per hour—$3.60	.072
1—Crane man @ $1.50 per hour	.03
1—Fireman @ $1.00 per hour	.02
1—Car cleaner @ $.60 per hour	.012
1—Crane rental @ $25.00 per day	.062
1—Crane fuel and oil—$8.00	.02
2—28-S Mixers new for $6,000 @ $25 a day	.062
2—Mixer fuel and oil—$8.00	.02
Total	$.328

2. Pumping Cost:

1—Pumpcrete operator @ $1.50 per hour	$.035
1—Helper @ $.60 per hour	.012
Pumpcrete charge-off	.10
Wearing parts	.04
Power, oil, grease—$10	.025
Pipe handling	.04
Total	$.252

Cost With 2 Pavers, 2 Cranes and Buckets

Pavers place 30 cu. yds. per hour each.

1. Mixing Cost:

	Per Cu. Yd.
2—Paver operators @ $1.50 per hour—$3.00	$.05
6—Cement men @ $.60 per hour—$3.60	.06
1—Batch man @ $.70 per hour	.012
1—Crane man @ $1.50 per hour	.025
1—Fireman @ $1.00 per hour	.016
1—Car cleaner @ $.60 per hour	.01
1—Crane rental @ $25.00 per day	.052
1—Crane fuel and oil—$8.00	.017
2—Pavers @ $50.00 per day	.10
2—Pavers, gas, oil—$8.00 each—$16.00	.033
Total	$.375

2. Batching Cost:

Batching costs estimated—$.15-$.25	low, $.15
2—Truck dumpers @ $.70 per hour—$1.40	.023
Cost of building roads, etc., estimated	.05
Total	$.223

3. Craning Cost:

2—Crane men @ $1.50 per hour—$3.00	$.05
2—Oilers @ $1.00 per hour—$2.00	.033
2—Bucket hookers @ $.70 per hour—$1.40	.023
2—Crane rentals @ $25.00 each—$50.00	.10
2—Crane gas and oil @ $8.00—$16.00	.033
2—Bucket rentals—$600.00	.006
Total	$.245

Cost Summary

1. Cost Summary from Car to Forms—Pumpcrete Method:

	Per Cu Yd.
(a) Mixing cost	$.328
(b) Pumping cost	.252
Total Cost	$.58

2. Cost Summary from Car to Forms — Paver, Crane and Bucket Method:

(a) Mixing cost	$.375
(b) Batching cost	.223
(c) Craning cost	.245
Total Cost	$.843

3. Cost Difference:

Craning cost	$.843
Pumping cost	.58
Saving with Pumpcrete	$.263

Though the preceding comparison was taken from an unusually large project where low costs were made possible by extensive placement, it is readily apparent that the ratio between pumping and craning would be maintained on smaller jobs. In many instances where considerable moving of equipment was necessary or where smaller pours caused more lost time and incidental labor, the differential would be increased in favor of the Pumpcrete. It will also be noted there are other obvious Pumpcrete advantages in that pipelines would be out of the way of other operations such as steel setting, excavations, etc.

CHAPTER VI COST ESTIMATES

SELECTING THE PUMPCRETE

Attention is called to the fact due consideration should be given to a number of points before the acquisition of permanent equipment. On occasions larger units than necessary or practical from some standpoints have been acquired merely because of a few relatively large pours. On other occasions, the smaller models have been acquired for reasons of economy when larger machines would have proved more economical in the long run for those particular organizations. On the ordinary job with average labor rates, it will take from 10,000 to 15,000 cu. yds. to balance the difference between the initial cost of a Model 160 and a Model 200 Single with labor savings.

Some of the chief factors involved in selecting the proper model Pumpcrete on the medium size and smaller contracts, are as follows:

1—Mixers and appurtenant equipment in the contractor's possession.

2—Pouring requirements of the job at hand.

3—Probable classification and size of future assignments for the equipment.

4—Concrete data, i. e., size of maximum aggregate, water, cement factors, etc.

5—Distances to be pumped.

6—Degree of portability that is likely to be required.

7—Balance between investment and estimated operating costs for the various size machines.

Estimating Placing Costs With the REX Pumpcrete

Concrete placing costs are herein assumed to consist of:

(a) *Fixed Charges:*

1—Cost of equipment, i. e., write-off on the investment.

2—Erection or installation, including freight charges.

3—Overhead, insurance and taxes.

(b) *Operating Costs:*

1—Maintenance and operation of all equipment involved.

(c) *Labor Costs:*

1—For mixing, transporting, distributing and finishing, including cleanup and incidental labor directly connected with concrete operations such as curing, protecting, rubbing and repairing before and after forms are stripped.

There is a wide range in appurtenant equipment and methods of application and all costs will vary with local labor and freight rates, job conditions, weather, engineering requisites and the personal equation. For these reasons the hypothetical job estimates to follow will be confined chiefly to Pumpcrete investment and write-off, maintenance, mixing, transporting and distributing labor, pipe handling costs and whatever else seems applicable to individual cases.

Fixed Charges on the Pumpcrete:

The fixed charges for a Pumpcrete plant will vary with every size machine and the amount of auxiliary equipment needed in the way of pipeline, elbows, short sections, distributing devices, etc. Detailed lists of Pumpcrete plants that closely approximate the average layout are found in Chapter IX.

Mechanical life in cubic yards pumped is a matter of definite record on the books of many users. The volumes shown below for each model, are considered quite conservative as they have been exceeded on many occasions in actual experience:

REX Pumpcrete, size	160-S	180-S	200-S	160-D	200-D
Rated capacity in cu. yd. per hour	15-20	20-27	27-33	30-40	54-66
Estimated plant cost	$6570.00	$9320.00	$9890.00	$13,410.00	$17,165.00
Est. cu. yd. life	60,000	80,000	100,000	120,000	200,000
Depreciation per cu. yd. (capital investment only)	$.109	$.116	$.099	$.112	$.086

The above figures are generally used in estimating fixed charges for the contractor who keeps his equipment or expects to use it on several jobs over an extended period. On large projects many companies establish an approximate salvage value for most of their equipment and make a complete charge-off against the job. In this event 50% is considered a fair estimate for salvage.

The estimator, through his knowledge of specific circumstances and intimacy with his organization's method of operation, will arrive at the

GEORGE H. JENNINGS
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S. C. MANSELL
SECRETARY

FORM O-8

WM. T. COLWELL
VICE PRESIDENT AND CHIEF ENGINEER
R. H. ANDERSON
GENERAL SUPERINTENDENT

POWERS-THOMPSON CONSTRUCTION COMPANY

GENERAL CONTRACTORS AND CONSULTING ENGINEERS
CONCRETE AND HEAVY CONSTRUCTION

TELEPHONES MAIN OFFICE 4254, YARDS 2-3493

YARDS LOCATED AT JOLIET, ILL.
MAIN OFFICE, 221 SOUTH CHICAGO STREET
JOLIET, ILLINOIS

CONTRACT NO.______
ESTIMATE NO.______
SUBJECT

March 13, 1936

Mr. F. H. Burlew
221 West Huron St.
Chicago, Illinois

My dear Mr. Burlew:

With reference to your inquiry concerning the pumpcrete that we purchased from you in 1935, we have experienced little or no trouble with this machine since it was installed, and I wish to compliment your company on its efficient operation.

I find that since we purchased the machine from you on June 15, 1935, we have pumped approximately 50,000 cubic yards of concrete. During this entire operation we have replaced only parts to the amount of $1425.00. We have no record of our labor costs in connection with this but you can probably arrive at the figures yourself. Summing the whole situation up, it seems very little compared to the yardage we have used, and in our way of thinking it is the most economical method of placing concrete, where large volumes are involved, that we have been able to find in the past.

If at any time you have prospective customers that you would like to show this set-up to we would be very glad to arrange it so that they can get into the plant.

Yours very truly,
POWERS-THOMPSON CONSTRUCTION CO.

Per Geo H Jennings
President & Treasurer.

GHJ/r

final cost by extending or rearranging the data to conform with his customary accounting system. Naturally it is expected similar allowances will be made for lost time, the rate of efficiency, etc., when comparison is drawn between Pumpcrete and other methods. In the following estimates, an average rate of efficiency is shown for hourly production in addition to a 10% allowance for equipment maintenance and incidental labor. Again, such items will vary (from almost nothing on up) with conditions and organizations and must be predetermined for individual applications.

Job Estimate No. 1

MODEL 160 PUMPCRETE

Assumed:

4,000 cu. yds. to be placed in reinforced concrete warehouse floors. The building is five stories high and covers an area of approximately 150 ft. x 250 ft. Ready mixed concrete to be delivered to the pump hopper. The contractor expects to complete the job within three months. He will keep the Pumpcrete as permanent equipment and write-off the investment on a yardage basis covering several jobs; will write-off 20% for a job of this size.

INVESTMENT:

1—Model 160 Pumpcrete, auxiliary equipment, 500 ft. of pipe with necessary fittings and connections, etc. (See Chapter IX) approximately	$6,568.50	

FIXED CHARGES PER CU. YD.:

1—Charge-off, 20% of purchase price	1,313.70	
2—Freight and installation (for purpose of this estimate)	200.00	
Total	$1,513.70	
Total fixed charge per cu. yd.		$.38

OPERATING COST PER CU. YD.:

1—Power (gas or electric, oil grease, valve compound	$.02	
2—Wearing parts, depending on concrete and operation (runs from .03 to .10 over life of machine—actual job experience shows average of .06)	.06	
3—Pipeline maintenance	.01	
Total		$.09

LABOR COST PER CU. YD.:

Based on average placing rate of 17 cu. yds. per hour with usual crew for this type of work. Change labor rates to suit local conditions.

Classification	*No. of Men*	*Rate*	*Total Per Hour*		
Pumpcrete operator	1	$1.25	$1.25		
Vibrator operator	1	.85	.85		
Puddlers (help with vibrator, handle pipe, spouts, etc.)	4	.75	3.00		
Foreman	1	1.00	1.00		
Total	7		$6.10		
Plus 10% for maintenance, dead time and incidentals. (This figure will vary according to job and weather conditions and efficiency of the organization.)			.61		
			$6.71		
Plus 12% for insurance and taxes			.81		
			$7.52		
Labor costs per cu. yd. at rate of 17 y. p. h.				$.44	
Plus average pipe handling cost for this type of work with labor rates shown				.07	
Total labor cost per cu. yd. for pumping and distributing concrete					$.51

SUMMARY:

Fixed charges per cu. yd.	$.38	
Operating cost per cu. yd.	.09	
Total cost per cu. yd.	.51	
Total labor cost per cu. yd. for pumping and distributing concrete		$.98

Job Estimate No. 2

MODEL 160 PUMPCRETE

Assumed:

9000 cu. yds. to be placed in 9 x 11 ft. tunnel in a metropolitan district. Contract is 6000 ft. long, 60 ft. below the surface in fairly good ground and will be worked in free air. Lining will be standard plates with 4" IB ribs on 24" centers.

It is estimated the ground will stand long enough to allow alternate pours on the arch and invert, i. e., invert one day and arch the next. A swing shift will alternate between headings and normal mining progress will continue during the arch pour. With the additional 4 hours mining time gained daily through this procedure (40 hours mining out of each 48 hour period in each heading), it is expected a 75 ft. arch form can be moved up and filled every other day in each heading.

The job will be worked from one central shaft.

A Model 160 on pneumatic tires will be towed between headings on the surface and place ready mix concrete by pumping down drill holes spaced at approximately 600 ft. centers.

The Concrete Procedure:

The concrete crew checks in and starts the 75 ft. arch pour in one heading. A 2 or 3 man steel gang goes into the other heading when the invert is mucked out, place the bottom reinforcing, make the pipeline setup and continue with the arch steel.*

*Steel gang is shown because it is an integral part of concrete operations in this setup. The form gang is not shown because they work a different shift and will vary considerably according to the type of forms in use.

The arch form is filled in approximately 4½ hours and the crew goes into the other heading to pour bottom. Two men are left behind to remove the arch pipe and goose neck and to clean up. In the meanwhile the Pumpcrete is cut loose on top and moved to the other heading; average time to move and get started pumping again, one-half hour. The 75 ft., plus or minus, bottom is placed in approximately 3 hours as full production will be realized on this type of work. The forms are moved up at night by another crew who also alternate between headings. They will set up the arch pipe and possibly put the finishing touches on the arch reinforcing.

COST ESTIMATE PER CU. YD. (Can be converted to cost per lineal foot of tunnel).

INVESTMENT:			
1—Model 160 Pumpcrete, cone Remixer and 1600 ft. 6" pipeline with necessary connections—approximately	$9300.00		
FIXED CHARGES PER CU. YD.:			
Contractor intends to keep the Pumpcrete as permanent equipment and will write it off over a 4 year period. The first year is charged against the current job.			
1—Charge-off (at 25% per year)	2325.00		
2—Interest (average per year at 6%)	348.75		
Total charge-off against job	$2673.75		
Charge-off per cu. yd.		$.30	
3—Installation and freight:			
For purpose of estimate set at	200.00		
Cost per cu. yd.		.02	
4—Incidental expenses native to this setup which could be classified with installation — approximately 8 drill hole setups at around $125 per setup including drilling truck ramp, etc. (Customary drilling cost is around $2 with casing per lin. ft. for good ground)	1000.00		
Cost per cu. yd.		.11	
Total fixed charges per cu. yd.			$.43
OPERATING COST PER CU. YD.:			
1—Power—gas, oil and grease		.02	
2—Wearing parts, .03 to .10, depending on concrete and operations—average		.06	
Total per cu. yd.			.08

LABOR COST PER CU. YD.:

Based on job average of 30 ft. per day per heading — approximately 90 yds. placed daily, 8 hour shift. Change labor rates to suit conditions.

Classification	*No. of Men*	*Rate Per Hour*	*Total Per 8 Hour Shift*	
Top Crew:				
Pumpcrete operator	1	$1.25	$10.00	
Labor for cleanup, help with move, etc.	1	.75	6.00	
Bottom Concrete Crew:				
Vibrator	2	1.00	16.00	
Bulkhead man	1	1.00	8.00	
Pipe man	1	1.00	8.00	
Utility	1	1.00	8.00	
Foreman	1		10.00	
Steel Gang:				
Tunnel labor	2	1.00	16.00	
Working foreman	1		10.00	
Totals	11		$92.00	
Plus 10% for maintenance and incidentals			9.20	
			$101.20	
Plus 18% for insurance, taxes			18.22	
Total labor cost per 8 hour shift			$119.42	
Total labor cost per cu. yd. for placing concrete and setting reinforcing exclusive of forming and the final topping				$1.33

SUMMARY:

Fixed charges per cu. yd.	$ .43
Operating cost per cu. yd.	.08
Labor cost per cu. yd.	1.33
Total cost per cu. yd. for pumping and placing concrete and setting reinforcing steel	$1.84
Total concrete cost per lin. ft. of tunnel (based on 1½ cu. yds. per lin. ft.)	$2.76

As an alternate for this setup 3 mining gangs could be employed full time in each heading. The crew that pulled the bottom could set the reinforcing and pour the invert from dump cars, then return to mining duties. In this setup arch concrete only would be placed with the Pumpcrete.

Job Estimate No. 3

MODEL 200 DOUBLE

Assumed:

50,000 cu. yds. to be placed in footings, columns, beams, slabs and walls of a sewage disposal, filtration plant, or similar structure. Buildings are two stories high and with the tanks, basins, etc., cover an area of several acres. Contract time enforces a tight schedule and 24 hour operation.

Materials will be unloaded from a siding on the job site, or trucked, and it is assumed all pours can be reached from one Pumpcrete setup. Cement will be bulked in bottom dump cars—aggregates will be stock-piled from truck haul and loaded into bins with a rented crane.

It was decided to use one 200 Double Pumpcrete and a central mixing plant with two 28-S Mixers. Will deduct probable salvage write-off against job.

For estimating labor costs per cubic yard we assume an overall average hourly placing rate of 45 cu. yds. per hour, or 70% efficiency of the maximum pouring rate. This is low enough because approximately 60% of the concrete will be fairly large slab pours which should be placed at an overall average of 55 cu. yds. per hour or

better. Walls and columns will be placed at an average rate of from 30 to 45 yds. per hour, depending on forms, etc.

Sometimes in such structures it is possible to speed up wall pours by using two pipelines from a dual Pumpcrete, one over each of two separate walls. This operation will increase pipe handling costs slightly and will require more labor for puddling, which is to be balanced against the increased progress.

INVESTMENT IN CONCRETE EQUIPMENT:

Pumpcrete and Accessories

1—Model 200 Double Pumpcrete with auxiliary equipment and Pugmill Remixer, 1000 ft. of 8" pipe with necessary fittings and connections $17,164.50

Mixers and Accessories

2—28-S Mixers, complete with gated batch hoppers, automatic vertical tanks with piping and batchmeters, at $3,420.00 ea. 6,840.00

Batcher Plant and Accessories

1—120 cu. yd. combination aggregate and cement bin, complete with 3 material scale and batcher, two-way chute for charging two mixers, bucket elevator and screw feed from bottom dump cement cars, high level bin signals, etc., approximately 5,700.00

Total $29,704.50

FIXED CHARGES PER CU. YD.:

1—Equipment charge-off, based on 50% salvage of preceding items $14,852.25

2—Freight, installation and erection, set at 2,000.00

3—5 months rental on a crane for loading aggregate bins at approximately $500.00 per month 2,500.00

$19,352.25

Total fixed charge per cu. yd. .... $.39

OPERATING COST PER CU. YD.:

1—Total power cost for concrete plant (varies according to equipment)—(gas or electric power, oil, grease and valve compound for Pumpcrete, will average .02 per cu. yd.) approximately .... $.08

2—Pumpcrete wearing parts, average (depending on concrete and operation, .03 to .10 per cu. yd.) .... .06

3—Pipeline maintenance (on large volume projects only) .... .01

Total .... $.15

LABOR COST PER CU. YD.:

Based on average placing rate of 45 cu. yds. per hour or 70% efficiency for this class of work: Change labor rates to suit local conditions.

Classification	*No. of Men*	*Rate*	*Total Per Hour*
Plant Crew:			
Crane operator	1	$1.50	$ 1.50
Oiler	1	.85	.85
Mixer operator	1	1.25	1.25
Batcher man (labor)	1	.75	.75
Labor on cement car	1	.75	.75
Labor for clean-up (utility)	1	.75	.75
Foreman	1	1.00	1.00
Pumpcrete Crew:			
Operator	1	1.25	1.25
Helper (double pumps only)	1	.85	.85
Distribution Crew:			
Concrete labor (average) (Vibration, puddling, pipe-handling, etc.)	7	.75	5.25
Finisher (average)	2	1.25	2.50
Foreman	1	1.00	1.00
Totals	19		$17.70
Plus 10% for maintenance and incidentals			1.77
			$19.47
Plus approximately 12% for insurance and taxes			2.34
			$21.81

Labor cost per cu. yd. for batching, mixing, transporting, placing and finishing, based on 75% efficiency at 45 cu. yds. per hour .... $.48

Plus estimated per cu. yd. cost of handling 8" pipeline (cost on slab .04 to .08 depending on layout of work. On walls and columns .10 to .20 for this type of work at labor rates shown) .... .10

Total labor cost per cu. yd. for concrete in place .... $ .58

SUMMARY:

Fixed charges per cu. yd. .... $.39

Operating cost per cu. yd. .... .15

Labor cost per cu. yd. .... .58

Total concrete cost per cu. yd. for equipment, batching, mixing, transporting, placing and finishing $1.12

Remarks:

These figures can be extended to include overhead, material hauling, delays from weather, curing, and what not, to meet specific conditions.

In the event one setup will not cover the job, the Pumpcrete can be moved at will and charged by wet-batching from the central plant in dump trucks at an additional cost of about 10 cents per cubic yard—based on purchase of three trucks at $1,000 each, charging the drivers' time at 75 cents per hour each against 45 cu. yds. per hour and including 2 cents per cubic yard for gas and maintenance on short hauls.

When some of the other advantages, self-evident in pipeline concrete under such circumstances, are considered, it will be seen that even on those projects where specifications or unusual aggregate conditions seem to prohibit use of the Pumpcrete method, it will quite often prove definitely economical to make changes in the aggregates, proportions of the mix or in the cement content to comply with pumping requirements.

CHAPTER VII THE MIXING PLANT

THE MIXING PLANT FOR A PUMPCRETE SETUP

Generally speaking, the mixer should be large enough to keep up with or stay slightly ahead of the pump, so the speed of placement will be regulated by the latter. The reason for this statement is that on some occasions the rated maximum hourly capacity of the Pumpcrete will be exceeded and the increase in production can only be realized if the mixer will meet the pickup. However, there is no hard and fast rule governing this phase of operation. Each user will find the machine readily adaptable to his customary methods of handling concrete.

While it is usually expedient to make use of available mixers and appurtenant equipment, the location and method of batching can often be worked out to gain important savings, both in the handling of materials and in the avoidance of conflict with other activities.

The mixing plant is, under some circumstances, one of the most important factors of successful Pumpcrete operation. Illustrations of this feature are to be found on pages 7, 12, 28, and elsewhere.

The following sketches and pictures illustrate the types of plants commonly used with the Pumpcrete; other combinations may prove fully as satisfactory.

14-S Mixer With Model 160 Pumpcrete

For isolated jobs where ready-mixed concrete or pavers are not available but where portability is a factor in keeping down costs, the use of a 14-S building mixer with the Model 160 Pumpcrete has found considerable favor. The particular advantage of this setup is the low cost of the plant proper, a standard 14-S. The mixer may be equipped with a wide skip to take truck or car batches from a central point. The capacity of the Model 160 (15 to 20 cu. yds. per hour) is more than enough to handle all the 14-S can turn out on normal mixing cycles.

If it is not convenient to mount the mixer on a platform (as shown in Figure 90) or on a trailer, for use with the power loader extension, the Pumpcrete may be set up in a pit under the mixer (shown in Figure 91) or installed on the lower side of a ledge, embankment, high curb, etc. The method of installation will be dictated by job conditions and the contractor's preference.

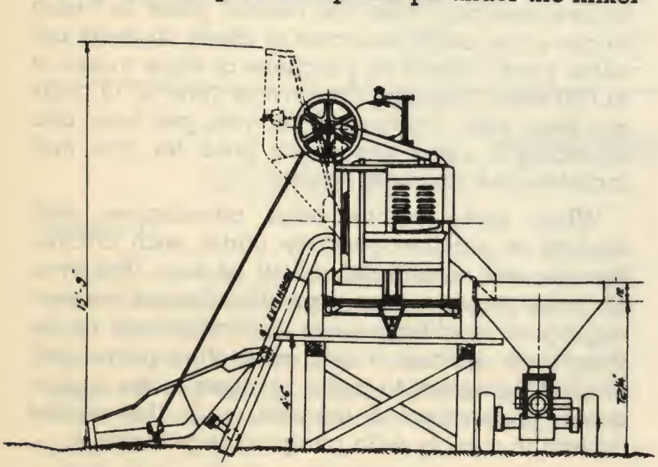


Figure 90—Model 160 setup under 14-S building mixer with Power Loader extension on platform. Mixer may also be mounted on trailer or barge for use with power loader extension.

Figure 91—Model 160 Pumpcrete setup in pit under 14-S Mixer.

Truck Mixers With the Pumpcrete

Maximum portability is secured when ready-mixed concrete is supplied to the Pumpcrete from Truck-Mixers. Especially with the Model 160 mounted on pneumatic tires and the Model 180 mounted on steel wheels, the use of Truck-Mixers discharging from a slight ramp or an embankment provides rapid movement for the entire setup from one part of the job to another.

This feature may prove the means for realizing an appreciable reduction in placing costs when the job is spread over a sizable area comprised of several structures in different locations, or is long and narrow, as in the case of some bridges, viaducts or tunnels, as Job No. 4 on page 12, and No. 7 on page 15.

Where discharging time is an important factor with Truck-Mixer operation, the Pumpcrete hopper may be extended to hold several yards of concrete.

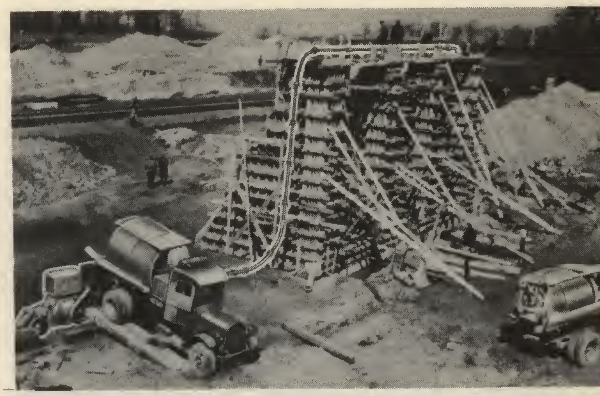


Figure 92—Truck-Mixer discharging into hopper of Model 160.

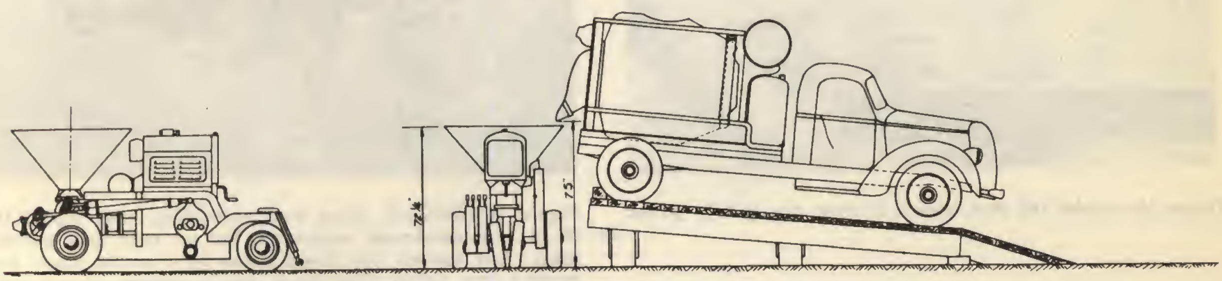


Figure 93—Model 160 with Truck-Mixers discharging from low ramp.

Pavers With the Pumpcrete

Greater mixing capacity and, generally speaking, the advantages of truck batching are to be secured if a Paver is used for the mixing end of the plant setup with the smaller model Pumpcretes.

Any of the various sizes of Pavers from the modern drum, 27-E, down to the old style, 21-E, can be satisfactorily used. Many of these old model Pavers are still good for mixing concrete. The Paver moves around the job under its own power, is readily set in position on a low timber mat, and can be served by standard batch trucks.

The use of two compartment drum Pavers in connection with the larger Pumpcretes makes a practical setup under some conditions where mobility and a large capacity are required. In some instances two 27-E Pavers may prove the economical setup with double Pumps.

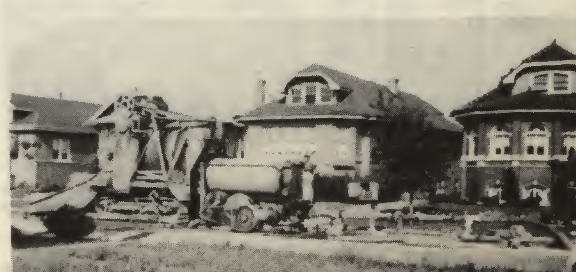


Figure 94—Model 180 Single with Rotary Remixer and 27-E Paver.

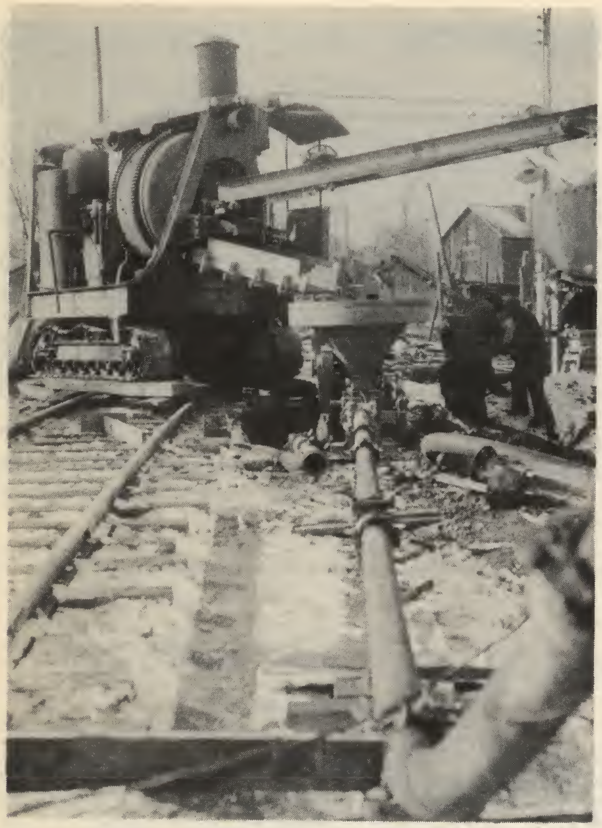


Figure 95—Model 160 with conical Remixer charged by paver.

Figure 96—Side hill plant with 14-S Mixer over Model 160; 36-yd., 2-compartment, aggregate bin on road side embankment. Bag cement slid down chute from road's edge; sand trucked from siding when plant was operating, coarse aggregate handled by crane and shuttle truck from stock pile. Six-man operation, exclusive of loading bins.

Figure 97—Side hill plant with two 28-S Mixers over a Double Pumpcrete; 105 yd., 3-compartment, aggregate bin, loaded by truck or stiff-leg derrick. Bag cement.

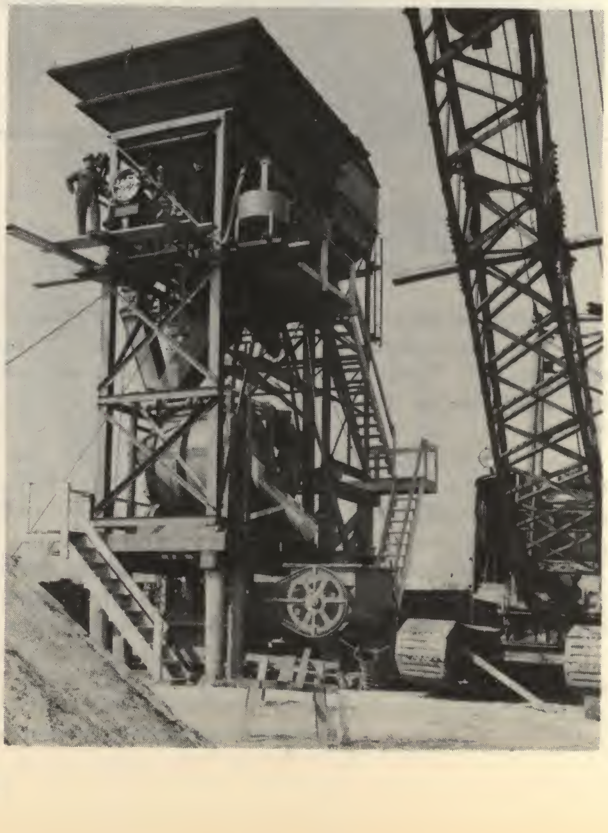


Figure 98 — Central Plant with 56-S Mixer over a Double Pumpcrete; 105-ton, 3-compartment, aggregate bin setup on coffer dam; loaded with crane and bucket from boat delivered stock piles or barges. Bulk cement delivered in barges and loaded in separate bin with Fuller Kenyon System. Seven-man operation for loading bins, batching, mixing and pumping.

Central Mixing Plants With the Pumpcrete

On many sizeable jobs in metropolitan areas where railway sidings or water transportation are available, a central plant gains the economies of eliminating trucking and rehandling aggregates, as well as the saving often to be realized in using bulk cement. In outlying districts where any sort of transportation is a big item, or where aggregates are processed and stock-piled near the site, the central plant is even more desirable in many instances. Under some conditions such plants are practical for the smaller mixers on relatively low yardage projects.

The Pumpcrete system allows a much wider latitude in the selection and setup of central plants; both as to type and location in relation to the job. The possibility for savings should be thoroughly investigated before a final decision is reached on just how batching and mixing shall be handled. On jobs covering large areas where pipelines will exceed the normal range limit, a practical arrangement under certain conditions has been to move the pump or pumps along to advantageous locations as the job progresses and wet-batch in dump trucks without moving the plant. Two trucks hauling 3 yards per trip will service a 200 double on a 1000 ft. haul around the average job. The Remixer hopper, as is sometimes the case with Truck-Mixers, is extended to hold 4 or 5 yards of concrete in order that the trucks may dump straight out and pull away. Where the time element in relation to mixing and final deposit in the forms is observed, the Pugmill Remixer has proven entirely satisfactory to engineering organizations as a reconditioner of concrete handled in this manner. In connection with wet-batching, the fact should be stressed that fairly good concrete is necessary.

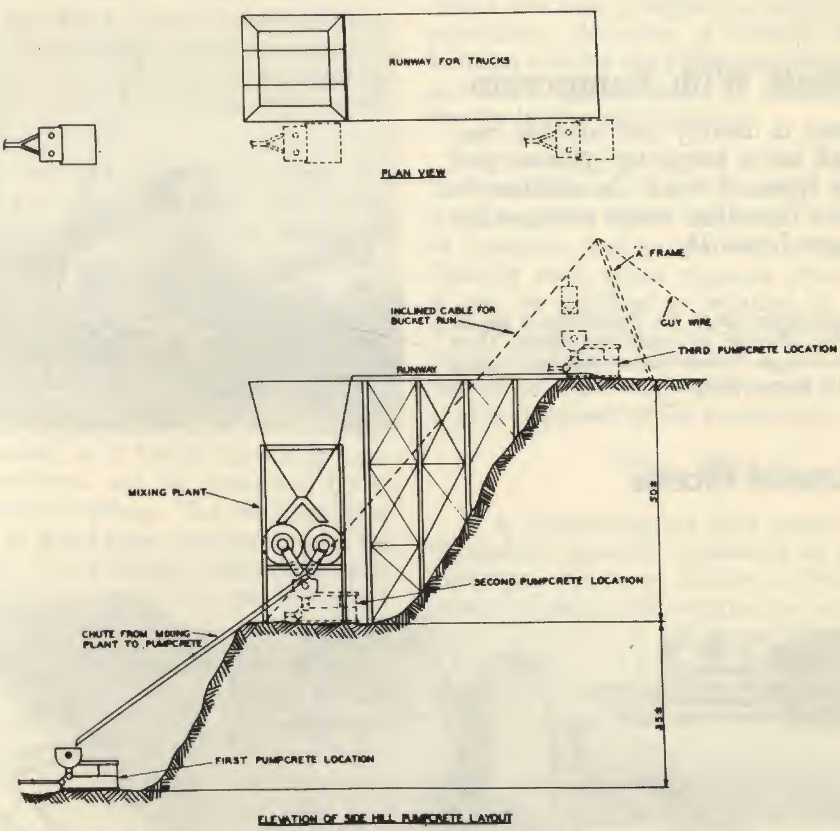


Figure 99—Illustrating one method of charging the Pumpcrete hopper from the central plant on side hill locations where the height of a structure, usually dams, precludes the possibility of reaching the top from one setup. A self-dumping bucket may be worked out for this setup.

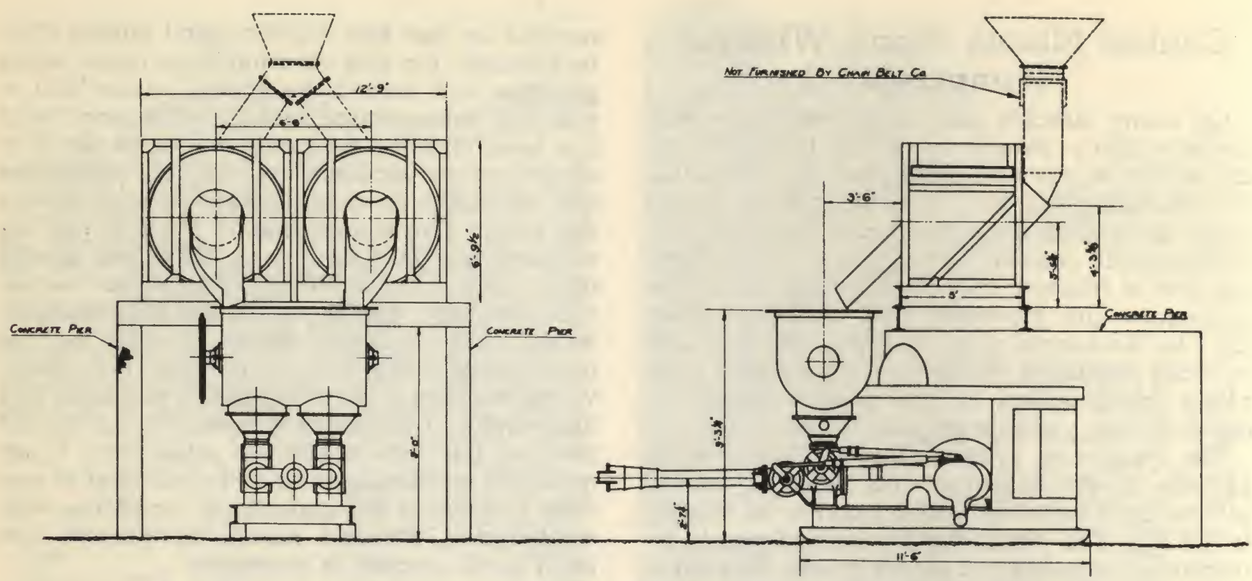


Figure 100—200 Double Pumpcrete with Pugmill Type Remixing Hopper and two REX 28-S Mixers. No batching plants or hoppers are shown as dimensions will vary with different types and makes. Sufficient dimensions are given on the Mixer and Pumpcrete to enable them to be fitted with suitable batching equipment. For Pumpcrete specifications see pages 86 and 87.

Floating Plants With Pumpcrete

The floating plant is usually just another central plant mounted on a barge for greater portability on certain types of work. In addition to the illustration here, excellent barge plant setups are shown on pages 7 and 14.

Figure 101—Floating plants in which the Pumpcrete is set on shore or on a dock and charged by boom conveyors. Care should be taken that the angle of belt incline does not exceed the limit for proper concrete delivery.

Tunnel Plants

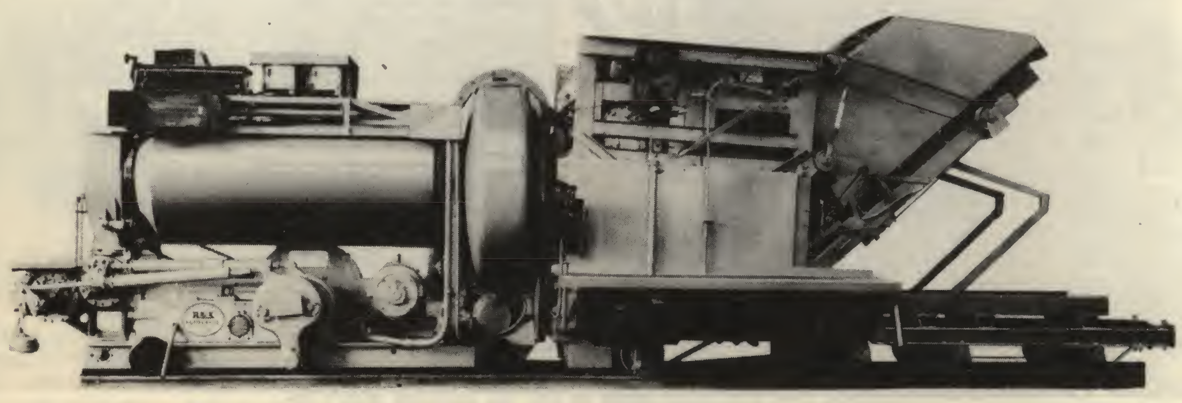


Figure 102—REX Tunnel Liner—Model 200 Single Pumpcrete with Rotary Remixer and low charging end coupled to 42-S Mixer. Mounted for 36" gauge track with self-traction motor. 2 Batch car in charging position.

CHAPTER VIII CONCRETE DATA

Pumpable Concrete

An almost infinite variety of concrete mixes is possible and even with given proportions of all the solid constituents, the characteristics change a great deal with a difference in gradation and water content. Nearly all of the mixtures commonly used are pumpable provided they are of a readily workable consistency. Most of the factors that make for workability also promote pumpability.

The matter of concrete mixtures is too complex to permit generalizing but provided there is enough good sand and the slump can be maintained at 2" or more, the results are consistently satisfactory. In some cases "enough" sand may exceed the top bracket of the specifications and with less than 4¾ bags of cement per yard, careful "working-out" is sometimes required to combine strength and workability. While concrete as dry as ½" slump has been pumped successfully, probably the most dependable slump for general conditions is about 3"; but the maximum pumping distance and height will be obtained with good concrete of 5" or 6" slump.

Concrete mixes that are difficult to pump include those with maximum coarse aggregate beyond the capacity of the machine or pipeline; mixes that are too dry or mixes that are too harsh. The harshness may be due to low sand content, poor sand (i. e., a deficiency of the finer gradations or a large gap in the intermediate gradations), an excess of pea gravel sizes (poor proportion between the small coarse aggregate and large coarse aggregate), lack of cement, coarse ground cement or a badly bleeding mix. Frequently the condition can be corrected by a slight change in proportioning. The addition of a moderate amount of sand from another source as a blend to supply the missing gradations will often retard bleeding in a poorly graded sand and improve both workability and pumpability.

The quality and grading of sand has much to do with the ease of pumping. Sand with approximately 15% passing a 50 mesh screen and 3% (as part of the 15%) passing a 100 mesh screen with the coarser sizes fairly well proportioned, is favorable. While these proportions of fines are desirable, it is probable that the majority of concrete mixes handled by the Pumpcrete have had sand somewhat coarser than this. If there is enough sand for a "well sanded" mix and a cement factor of 5½ or 6 bags per yard, the fineness modulus of the aggregates is not so important from the pumping standpoint.

The pumping rate is affected by the consistency and workability of the mix. Concrete is fed through the opening at the bottom of the hopper into the cylinder of the Pumpcrete largely by gravity but is assisted by the vacuum created by the suction stroke of the piston. The pumping rate is in direct ratio to the degree to which the cylinder is filled on each stroke. Concrete containing an average amount of cement with a well-graded sand will feed more readily than will a harsh or lean concrete mixture. Similarly, extremely dry concrete will not feed as readily as will concrete with a 3" or 4" slump.

Relative Pumpabilty of Gravel As Compared to Crushed Stone Aggregates

By and large, gravel as coarse aggregate, due to its rounded contours and lower void ratio, produces the best pumping concrete mixes for long pipelines. However, a cubical breaking stone, leaning toward the higher brackets, is satisfactory provided enough sand is added to compensate for the higher void content.

A flat-breaking, angular stone, particularly where the particles below a ½" screen are all chips and flats, requires better sand and more rigid control of grading and proportioning for good results. Usually such stone requires over-sanding before it can be puddled or worked in confined areas. By the same token it is harder to pump than the more workable mixes but it can usually be corrected both for workability and pumpability with a little juggling of the proportions.

The Remixer

It is recommended that every Pumpcrete intended for general conditions be equipped with a Remixer. Mixtures having a tendency to segregate will definitely require the use of the Remixer. Even though it is not required for the job under consideration, it is very probable that some time during its life the Pumpcrete will be called upon to place concrete of such consistency that the use of the Remixer is essential to its successful operation.

The Remixer is helpful in blending one batch of concrete with another—thereby minimizing the effects of any lack of uniformity in the concrete as delivered to the Pump (the succeeding batch may be used to correct one delivered in poor condition). In addition, the pumping rate is often increased through use of the Remixer as it tends to make the concrete flow more readily into the cylinder. This is especially true of the drier mixes.

Pumpcrete Job Analysis Sheet

The Pumpcrete has been applied on projects to which it did not belong, either from the standpoint of simple cost, excessive mechanical requirements, or on downright impossible concrete mixes. It has also, on occasions (and in common with most construction equipment to a greater or lesser extent), been sadly mishandled in the manner of its application. While these instances are exceptional and of minor consequence in the general development of the pump, they must be kept in mind and, to as great an extent as possible, eliminated.

For these reasons we reserve the right at all times to pass judgment on concrete aggregates, mix proportions and pumping requirements before releasing Pumpcrete equipment to the new user.* The job analysis sheet on the opposite page is to be filled out and returned to Milwaukee with each order. The sheet is self-explanatory. It is just a question of filling in the data as completely as is conveniently possible.

The specifications issued by architectural or engineering organizations show the permissible screen and sieve analysis of the aggregates and water cement ratio. This information is not definite. For example, it may be specified the sand shall have from 0 to 6% passing the 100 mesh and from 5 to 30% passing the 50 mesh sieve. It is obvious that if the sand hit the low figure in both brackets, it would cause pumping difficulty on long lines; particularly if it was badly pocketed on one of the intermediate sieves and of a structural shape that would allow considerable bleeding. We are interested in an actual analysis of the aggregates that are going to be used on the job.

**Note:* Chain Belt Company does not attempt to control the manner in which equipment once released, is handled on future applications. However, we are always glad to cooperate to the fullest extent of our seven years pumping experience with any and all Pumpcrete owners and users.

Details of Concrete Mixtures Placed by Pumpcrete on Representative Jobs

This table is a supplement (for the years 1937, 1938 and 1939) to the jobs listed in Charles F. Ball's* paper, "Concrete By Pump and Pipeline," in the Jan.-Feb., 1936, Journal of the American Concrete Institute.

JOB	1 CHICAGO RIVER SANITARY LOCK	2 GRAND RAPIDS WHOLESALE GROCERY CO. WAREHOUSE	3 CATARACT FALLS DEVEL. SACO, MAINE	4 PLEASANT HILL DAM, OHIO		
PUMPCRETE MODEL	180 D	180 S	180 D		200 S	
YEAR	1937-38	1937	1937	1937	1937	1937
YARDAGE	35,000	4000	14,000		7000	
Cement	525	376	470	658	564	470
Admix						
Sand	1550	1200	1335	1700	1481	1625
Coarse Aggregate						
½	X	X	X	X	X	X
¾	X	X	X	X	X	X
1	X	X	X	1729	894	899
1¼	X	X	X		X	X
1½	X	2250	X		X	X
2	X		1930		1341	1348
2½	1925					
3						
Water		250	202			
Sand	Good	Good	Good	Good	Good	Good
Coarse Aggregate	Gravel	Gravel	Cr. Limestone	Cr. Stone & Gravel	Cr. Stone & Gravel	
Slump	2 — 6	2 — 4	2 — 6	2 — 6	2 — 6	2 — 6
Pumpability	Good	Good	Good	Good	Good	Good
SIEVE ANALYSIS OF SAND — PER CENT PASSING						
⅜			95.6	100	100	100
4	94		92.0	99	99	99
8	74	96.5	82.9	75	75	75
16	52	84.0	67.3	50	50	50
30	40	56.5	36.2	26	26	26
50	23	9.0	12.2	12	12	12
100	3	1.0	2.1	5	5	5
200						

*Chief Engineer, Construction Equipment Division, Chain Belt Co., Milwaukee.

Rex Pumpcrete Job Analysis

PAGE 1

NAME OF JOB ______

LOCATION ______

CONTRACTOR ______

ADDRESS ______ BY ______

______ DATE ______

ATTENTION OF:	NOTED

GENERAL NATURE OF JOB: ______

Concrete cu. yd. on job, total ______
Rate, cu. yd. per hour required ______
Max. Horizontal distance to pump ______
Date expect to start pumping ______
Time Pumpcrete required on job. ______
Gasoline or electric drive ______
Will air or water be used for washout ______

UPGRADE PUMPING:
Height to be pumped (vertical distance) ______
Approx. slope (deg. angle to horizontal) ______
Max. height if concrete must be pumped over hump. ______

DOWN GRADE PUMPING:
Drop in feet total ______
Approx. slope (deg. angle to horizontal) ______
Horizontal distance after drop ______

WAGE RATES PER HOUR
Concrete Laborer ______
Pumpcrete Operator ______
Vibrator Man ______
Concrete Finisher ______
Carpenter ______
Hoisting Engineer ______

STRUCTURAL DETAILS:
Attach sketches showing:
(a) General dimensions & elevations.
(b) Pumpcrete location proposed.
(c) Pipeline layout proposed.
(d) Dimensions and spacing of footings, walls & piers.
(e) Slab thickness & type.
(f) Any special features.

SPECIAL CONDITIONS: Describe fully any conditions requiring special distributing, pipe handling, or pumping methods: ______

CONCRETE QUANTITIES:

	CONCRETE TO BE PUMPED			
TYPE CONCRETE WORK	CU. YD.	CLASS	SLUMP	REMARKS
Footing - Foundation (Below Ground)				
Piers - Abutments (Above Ground)				
Columns				
Beams				
Walls				
Slab				
Tunnel Invert				
Tunnel Arch				

Total to be pumped ______ cu. yd. Class ______
Total to be pumped ______ cu. yd. Class ______
Total to be pumped ______ cu. yd. Class ______

PAGE 2

Rex Pumpcrete Job Analysis

CONCRETE SOURCE:

Job Mixing Plant ______ No. & Size of Mixers ______ Mixing time per batch ______
Location of Mixer with respect to Pumpcrete ______

Central Plant Mixing ______ Size Central Mixer ______ Size batches hauled ______
Agitator or non-agitator type trucks used ______ Length of haul ______

Transit Mix Concrete ______ Size Transit Mixer ______ Length of haul ______

Method of Charging Pumpcrete: Chute ______ Conveyor ______ Elevator ______
Note any other method used ______

CONCRETE BATCH ANALYSIS: Based on 1 cu. yd. of Concrete.

Material	CLASS Concrete			CLASS Concrete		
	Kind	Grading	Weight(Dry) Pounds	Kind	Grading	Weight(Dry) Pounds
Cement						
Admixture						
Sand						
Coarse Aggregate 1/4" - 3/4" †	*			*		
3/4" x 1-1/2" †	*			*		
1-1/2" - 3" †	*			*		
WATER(including free water in aggregates)		(Gal.perbag)	(#per cu. yd.)	WATER	(Gal.perbag)	(#per cu. yd.)
Total Weight in Pounds						
SLUMP expected: (MIN.- MAX.)						

* Specify gravel, crushed stone, slag, etc. † If other grading is used indicate size.
Source of information for Batch Analysis ______

SAND SIEVE ANALYSIS

Size Screen	3/8"	#4	#8	#16	#30	#50	#100	#200	
% Passing									

Source of Information ______

COARSE AGGREGATE SCREEN ANALYSIS:

Size Screen	3"	$2\frac{1}{2}$"	2"	$1\frac{1}{2}$"	1"	3/4"	1/2"	3/8"	#4
No......... % Passing									
No......... % Passing									
Combined. % Passing									

Source of Information ______
Remarks: ______

JOB	5 NECHES RIVER BRIDGE, PORT ARTHUR, TEXAS	6 BARTLETT DAM, ARIZONA	7 AMERICAN VISCOSE CO. FRONT ROYAL PLANT	8 KENDRICK PROJECT, ALCOVA DAM, TUNNELS & SPILLWAY & CASPER CANAL	9 LANCASTER ST. BRIDGE, FT. WORTH, TEXAS
PUMPCRETE MODEL	160 S	200 D	180 S	200 Sgl. & Dbl.	160 S
YEAR	1937-38	1937-38	1937-38	1933-38	1938-39
YARDAGE	6000	180,000	38,000	81,600	9000
Cement	564	470	515	500	564
Admix					
Sand	1130	1180	1350	1250	1286
Coarse Aggregate					
½	X	X	X		X
¾	X	790	X		X
1	X	X	X	900	X
1¼	X	X	X	X	X
1½	2150	680	2000	1250	1904
2		X			
2½		X			
3		790			
Water	275	270	235	280	280
Sand	Good	Good	Good	Good	Good
Coarse Aggregate	Gravel	Cr. Gravel	Cr. Gravel	Cr. Gravel	Gravel
Slump	1 — 4	2½ — 4	4 — 6½	1½ — 5	3 — 6
Pumpability	Good	Fair	Good	Good	Good

SIEVE ANALYSIS OF SAND — PER CENT PASSING

⅜				100	
4	98	98	100	98.7	99
8	88	87	91	84.2	
16	75	68	71	67.2	61
30	57	40	46	38.2	
50	12	16	19	9.0	18
100	0.5	5	4	2.0	3
200					

Comments on Classification As to Pumpability of Mixes Shown in Tables

1—First class aggregates. This mix pumped very well on pipelines far in excess of rated capacities.

2—Required the assistance of a Remixer to prevent packing in the hopper but pumped exceptionally well for 4 bag concrete.

3—Undersanded with crushed stone aggregate and hard to handle with 1 x 2.4 x 4.6 proportioning. When changed to weights shown, these aggregates produced a good pumpable mix.

4—This sand apparently would pump easily at almost any normal proportioning.

5—Very good concrete for pumpabilty. See page 10 for details of job.

6—Listed as fair for pumpability. Considering the skinniness of the mix and the distances concrete was transported in unfavorable weather conditions, it would probably be classified as excellent under many less exacting circumstances. See page 29 for job details.

7—On this project pit run sand was dug near the job site. A very good sand for pumpability was discovered and no difficulties were experienced in pumping lines well over the rated limitations.

JOB	*10* ALUMINUM ORE CORP. STORAGE PLANT, MOBILE, ALA.	*11* RACINE AVE. PUMPING STATION, CHICAGO, ILL.	*12* NEWBERRY MICHIGAN STATE HOSPITAL	*13* GREEN BAY RESERVOIR	*14* SOY BEAN PROCESSING PLANT, DECATUR, ILL.
PUMPCRETE MODEL	180 S	200 D	160 S	160 S	160 S
YEAR	1938	1938-39	1938	1938	1939
YARDAGE	6000	25,000	3300	1200	2000
Cement	564	517	545	564	470
Admix					
Sand	1200	1550	1847	1306	1500
Coarse Aggregate					
½	X	X	X	X	X
¾	X	X	X	X	X
1	2300	X	X	1975	X
1¼		X	X		X
1½		1925	2088		X
2					1700
2½					
3					
Water			300	300	
Sand	Bad	Good	Fair	Good	Fair
Coarse Aggregate	Gravel	Gravel	Cr. Stone	Cr. Stone	Cr. Limestone
Slump	2 — 6	3 — 6	2 — 6	2 — 6	3 — 5
Pumpability	Bad	Good	Good	Good	Good

SIEVE ANALYSIS OF SAND — PER CENT PASSING

⅜		100	100		100
4	98.9	96	89	95	95
8	95.7		80		86
16	91.1	58	64		74
30	73.6		37		56
50	6.4	18.2	6	15	17
100	.6	1	1	4	1.4
200					

8—Several machines pumped a total of 81,000 cubic yards into diversion tunnels, syphons and various structures over a 5 year period on this project. Contractors and the engineering organization all rate the aggregates as producing very good concrete for pumpability.

9—Excellent concrete in every respect. See page 12 for job data.

10—As shown in the analysis, the only available sand for this job was very badly pocketed between the 30 and 50 sieves. The concrete bled so profusely it could not be allowed to stand in the machine or pipeline longer than 5 to 10 minutes without trouble.

11—Very good concrete, pumped winter and summer at any slump.

12—Sand was short on fines but mix had enough stone dust to offset the deficiency.

13—Good sand but a little on the lean side for crushed stone aggregate. However, the mix was okay.

14—Stone gradation inclined to be a little ragged for consistency but had enough good sand and pumped very well.

15—An undersanded mix with a deficiency of fines yet it pumped surprisingly well on short lines, getting 20 yards per hour on a 2" slump. This concrete was so harsh it was almost unmanageable in reinforced wall forms, an exception to the usual rule.

16—This was a lake sand very sharp and clean; spotty on the grading, running to excessive fines with a gap at the 16 and 30 sieves at times. It pumped exceptionally well with gravel aggregates, but when the fines were running high (sometimes up to 45% through

JOB	15 SEWAGE TREATMENT PLANT, MARSHALL-TOWN, IA.	16 SEWAGE TREATMENT PLANT, GARY, IND.	17 COLD STORAGE PLANT, OTTUMWA, IA.	18 SUBWAYS, CHICAGO, ILL.	19 7 FT. COMBINED SEWER TUNNEL, ROCHESTER, N. Y.	20 STEAM STATION & DAM CLIFFSIDE, N. C.
PUMPCRETE MODEL	160 S	160 S	160 S	200 Sgl. & Dbl.	160 S	180 S
YEAR	1939	1939	1939	1939	1939-40	1939-40
YARDAGE	7000	20,000	8000	175,000	7400	30,000
Cement	564	564	502	564	564	541
Admix			33# Lime			
Sand	1380	1402	1342	1698	1435	1370
Coarse Aggregate						
½	X	X	X	X	X	X
¾	X	X	1792	X	942	X
1	1823	X		X		X
1¼		X		X		X
1½		1977		1830	942	1922
2						
2½						
3						
Water						305
Sand	Bad	Good	Poor	Good	Good	Bad
Coarse Aggregate	Cr. Limestone	Gravel	Gravel	Gravel	Gravel	Cr. Quartzite
Slump	1½ — 2½	2 — 6	3 — 5	3 — 6	2 — 4	1 — 2
Pumpability	Good	Good	Good	Good	Good	Fair

SIEVE ANALYSIS OF SAND — PER CENT PASSING

⅜	100	100	100	100	100	
4	99	98	99	92	98	88
8	85	80	84	75	83	77.5
16	57	58	60	59	54	56
30	30	35	28	46	26	27.5
50	5	12	3	25	9	6.5
100	1	2	1	4	3	1.5
200						

the 50 sieve) gave trouble on long pipelines with flat breaking, dusty limestone. With a little closer grading and less dust, it would probably have been okay for usual conditions with the same stone.

17—This was a harsh sand with a marked deficiency of fines but had a high water retaining quality assisted by the lime, no doubt, and pumped very well for all practical purposes. Believe this sand was from same source as No. 15.

18—Several contractors have pumped around 175,000 of the 390,000 yards that will be placed by Pumpcrete on this project. They are all using aggregates from the same source with approximately the same proportions which are changed slightly from time to time to meet varying conditions. Sand, from two sources is blended to get approximately the grading shown (one sand is pocketed on the lower brackets, the other in the middle). Either sand pumps very well at almost any slump when combined with gravel aggregate but would require more rigid control of the blended grading with crushed aggregate.

19—In some respects this could be called an ideal mix. It was wet-batched several miles in all weather and abused in other respects without noticeable ill effects to pumping.

20—These aggregates required an extremely low water ratio to get the required strength although the stone had a cubical break and was well bunched above the ¾" screen. Sand was too harsh to pump long lines at a 1" slump. Production was low with dry concrete but the company decided it was fast enough and would not add cement for a higher slump.

CHAPTER IX PUMPCRETE DATA

Cost of Average Pumpcrete Plant — Unit Prices

MODEL 160 PUMPCRETE

TYPICAL AVERAGE PLANT

REX 160 Pumpcrete with gasoline engine, integral Agitator sub-hopper, mounted on skids			$3930.00
Cone Remixer			450.00
4—Pneumatic Tires if required	$140.00		
Auxiliary equipment for Model 160 Pumpcrete required with 6" Pipeline		$ 350.00	
50—10 ft. sections 6" pipe @	25.00	1250.00	
4— 5 ft. sections 6" pipe @	21.75	87.00	
2— 3 ft. sections 6" pipe @	20.50	41.00	
1— 2 ft. section 6" pipe @	19.75	19.75	
1— 1 ft. section 6" pipe @	19.25	19.25	
2—90 deg. elbows @	38.50	77.00	
4—45 deg. elbows @	28.50	114.00	
2—22½ deg. elbows @	23.50	47.00	
11¼ deg. elbows (if required)	21.00		
1—Pipe Choke (if required)	50.00		
1—Dent Remover (if required)	45.00		
1—Shut-off Valve (if required)	35.00		
1—10 ft. Distributing Spout with 2 discharge gates		50.00	
1—Foot for Distributing Spout		8.50	
1—Roller Type Spout Hanger with Deflector		25.00	
			$2088.50
Minimum stock of spare wearing parts			100.00
			$6568.50

Installation engineer supplied free of charge for ten days' service east of 105th meridian.

The above prices are subject to change without notice.

MODEL 180 SINGLE PUMPCRETE

TYPICAL AVERAGE PLANT

REX 180 Pumpcrete with gasoline power, sub-hopper, overhead control			$5050.00
*Pugmill Remixer with gasoline engine			1600.00
Auxiliary Equipment for Model 180 Pumpcrete required with 7" Pipeline		$ 475.00	
50—10 ft. sections 7" pipe @	$30.00	1500.00	
4— 5 ft. sections 7" pipe @	25.75	103.00	
2— 3 ft. sections 7" pipe @	24.00	48.00	
1— 2 ft. section 7" pipe @	23.25	23.25	
1— 1 ft. section 7" pipe @	22.50	22.50	
2—90 deg. Elbows @	41.50	83.00	
4—45 deg. Elbows @	31.50	126.00	
2—22½ deg. Elbows @	26.50	53.00	
11¼ deg. Elbows (if required)	24.00		
1—Pipe Choke (if required)	55.00		
1—Dent Remover (if required)	50.00		
1—Shut-off Valve (if required)	43.00		
1—10 ft. Distributing Spout with 2 discharge gates		50.00	
1—Foot for Distributing Spout		8.50	
1—Roller Type Spout Hanger with Deflector		25.00	
			$2517.25
Minimum stock of spare wearing parts			150.00
			$9317.25
*Rotary Remixer price		$2740.00	

Installation engineer supplied free of charge for fourteen days' service east of 105th meridian.

The above prices are subject to change without notice.

MODEL 200 SINGLE PUMPCRETE

TYPICAL AVERAGE PLANT

REX 200 Single Pumpcrete with gasoline power, sub-hopper, overhead control			$5600.00
*Pugmill Remixer with gasoline engine			1600.00
Auxiliary Equipment for Model 200 Pumpcrete required with 7" Pipeline		$ 475.00	
50—10 ft. sections 7" pipe @	$30.00	1500.00	
4— 5 ft. sections 7" pipe @	25.75	103.00	
2— 3 ft. sections 7" pipe @	25.00	48.00	
1— 2 ft. section 7" pipe @	23.25	23.25	
1— 1 ft. section 7" pipe @	22.50	22.50	
2—90 deg. Elbows @	41.50	83.00	
4—45 deg. Elbows @	31.50	126.00	
2—22½ deg. Elbows @	26.50	53.00	
11¼ deg. Elbows (if required)	24.00		
1—Pipe Choke (if required)	55.00		
1—Dent Remover (if required)	50.00		
1—Shut-off Valve (if required)	43.00		
1—10 ft. Distributing Spout with 2 discharge gates		50.00	
1—Foot for Distributing Spout		8.50	
1—Roller Type Spout Hanger with Deflector		25.00	
			$2517.25
Minimum stock of spare wearing parts			175.00
			$9892.25
*Rotary Remixer price		$2740.00	

Installation engineer supplied free of charge for fourteen days' service east of 105th meridian.

The above prices are subject to change without notice.

MODEL 160 DOUBLE PUMPCRETE

TYPICAL AVERAGE PLANT

REX 160 Double Pumpcrete with gasoline power, conical hopper, overhead control			$7860.00
Pugmill Remixer with gasoline engine			1750.00
Auxilary Equipment for Model 160 Pumpcrete required with 7" Pipeline		$ 625.00	
75—10 ft. sections 7" pipe @	$30.00	2250.00	
6— 5 ft. sections 7" pipe @	25.75	154.50	
3— 3 ft. sections 7" pipe @	24.00	72.00	
2— 2 ft. sections 7" pipe @	23.25	46.50	
2— 1 ft. sections 7" pipe @	22.50	45.00	
2—90 deg. Elbows @	41.50	83.00	
6—45 deg. Elbows @	31.50	189.00	
2—22½ deg. Elbows @	26.50	53.00	
11¼ deg. Elbows (if required)	24.00		
1—Pipe Choke (if required)	55.00		
1—Dent Remover (if required)	50.00		
1—Shut-off Valve (if required)	43.00		
1—10 ft. Distributing Spout with 2 discharge gates		50.00	
1—Foot for Distributing Spout		8.50	
1—Roller Type Spout Hanger with Deflector		25.00	
			$3501.50
Minimum stock of spare wearing parts			200.00
			$13,411.50

Installation engineer supplied free of charge for fourteen days' service east of 105th meridian.

The above prices are subject to change without notice.

MODEL 200 DOUBLE PUMPCRETE

TYPICAL AVERAGE PLANT

REX 200 Double Pumpcrete with gasoline power, sub-hopper, overhead control			$ 9750.00
Pugmill Remixer with gasoline engine			1850.00
Auxiliary Equipment for Model 200 Double Pumpcrete required with 8" Pipeline		$ 675.00	
100—10 ft. sections 8" pipe @	$36.00	3600.00	
6— 5 ft. sections 8" pipe @	31.00	186.00	
4— 3 ft. sections 8" pipe @	29.00	116.00	
2— 2 ft. sections 8" pipe @	28.00	56.00	
2— 1 ft. sections 8" pipe @	27.00	54.00	
2—90 deg. Elbows @	54.00	108.00	
8—45 deg. Elbows @	40.00	320.00	
2—22½ deg. Elbows @	33.00	66.00	
11¼ deg. Elbows (if required)	29.50		
1—Pipe Choke (if required)	60.00		
1—Dent Remover (if required)	55.00		
1—Shut-off Valve (if required)	47.50		
1—10 ft. Distributing Spout with 2 discharge gates		50.00	
1—Foot for Distributing Spout		8.50	
1—Roller Type Spout Hanger with Deflector		25.00	
			$ 5264.50
Minimum stock of spare wearing parts			300.00
			$17,164.50

Installation engineer supplied free of charge for fourteen days' service east of 105th meridian.

The above prices are subject to change without notice.

Pipe Line Data

The following table of Pipe Line Data is based on converting the pumping resistance of any combination of straight pipe, bends and differences in elevation to the resistance of an equivalent length of straight horizontal pipe:

Pipe Size	*Equivalent Length of Straight Horizontal Pipe**	*Vertical Distance***	*Maximum Aggregate Square Screen Size*
WITH REX PUMPCRETE No. 200 (7.9") DOUBLE			
8" O. D.	1000 ft.	100 ft.	3"
7" O. D.	600 ft.	100 ft.	2½"
WITH REX PUMPCRETE No. 200 (7.9") SINGLE			
8"	1000 ft.	100 ft.	3"
7"	800 ft.	100 ft.	2½"
WITH REX PUMPCRETE No. 180 (7.1") SINGLE			
7"	1000 ft.	120 ft.	2½"
6"	800 ft.	100 ft.	2"
WITH REX PUMPCRETE No. 160 (6.3") DOUBLE			
7"	1000 ft.	100 ft.	2"
6"	800 ft.	100 ft.	2"
WITH REX PUMPCRETE No. 160 (6.3")			
6"	800 ft.	100 ft.	2"

Example:

Assume the project is equipped with a single Pumpcrete, Model No. 200, pumping through 8" O. D. pipeline.

The total actual length of pipeline is 360 feet, which is made up of the following sections:

320 ft. straight pipe
2—90° bends
4—45° bends

There is a vertical lift at the end of the pipeline of 40 ft.

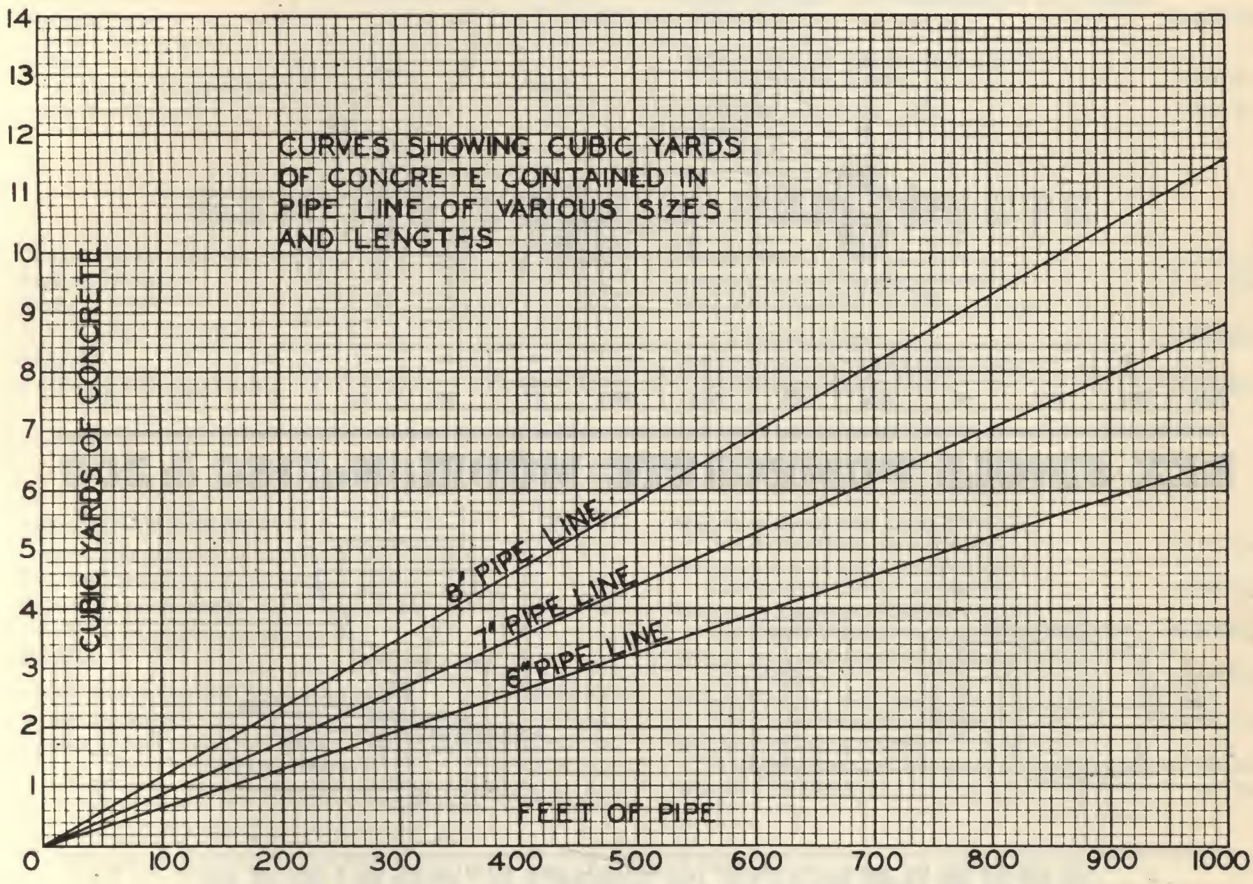
The equivalent length of straight horizontal pipe is determined as follows:

320 ft. straight pipe Equals	320 ft.
2—90° bends (Equivalent to 40 ft. straight pipe)	80 ft.
4—45° bends (Equivalent to 20 ft. straight pipe)	80 ft.
40 ft. vertical lift (Equivalent 1 ft. vertical equals 8 ft. horizontal)	320 ft.
	800 ft.

*A 90 degree bend is figured as equivalent to 40 ft. of horizontal piping, a 45 degree bend equivalent to 20 ft., and 22½ degree bend equivalent to 10 ft.

**Not over 200 ft. of pipe actually. A combination of horizontal and vertical distances is to be calculated on the basis of 1 ft. of vertical equaling 8 ft. of horizontal pumping. The total equivalent distance should *not* exceed the equivalent horizontal pumping distances shown in the tabulation.

The following straight line curves are presented so the contractor may better judge the amount of concrete in the pipeline. This information is of great value in holding concrete losses to a minimum when nearing the end of a pour.



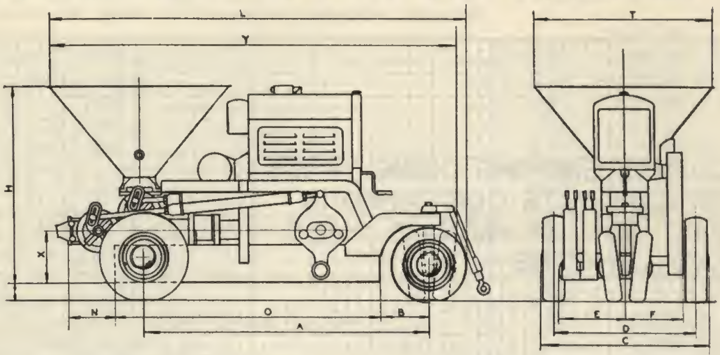
The quantity of water required to clean out the pipeline with the Go-Devil may be computed from the above table by converting cubic yards of concrete into gallons of water. (1 cubic yard = 202½ gallons).

TIME REQUIRED IN MINUTES
For Concrete Pumped Through 100 Feet of Pipeline

Pumping Rate	60 yds. per hr.	50 yds. per hr.	40 yds. per hr.	30 yds. per hr.	25 yds. per hr.	20 yds. per hr.
6" Pipe.......	.65	.78	.97	1.30	1.56	1.95
7" Pipe.......	.88	1.05	1.32	1.76	2.11	2.64
8" Pipe.......	1.16	1.39	1.74	2.32	2.78	3.48

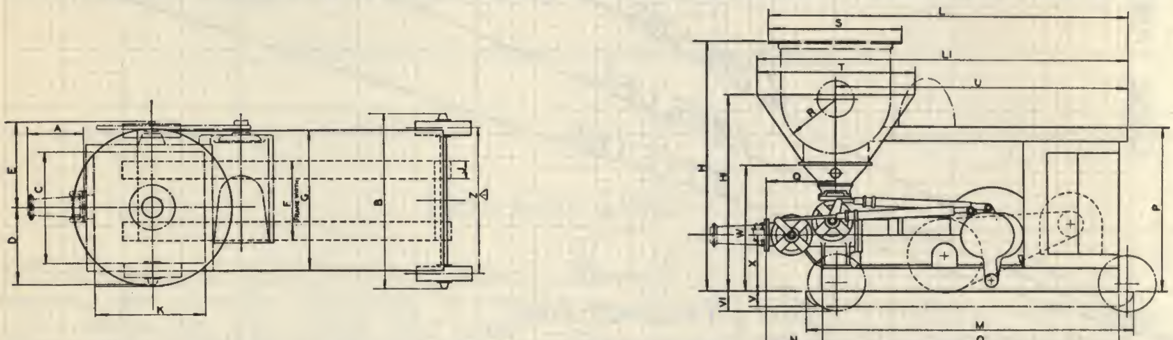
DIMENSIONS

REX SINGLE PUMPCRETE MODEL No. 160



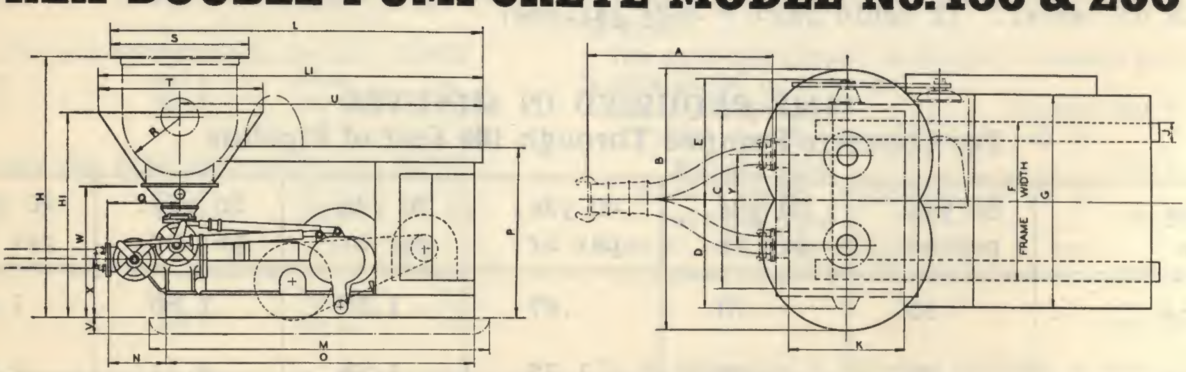
A	B	C	D	E	F	H	L	N	O	T	V	X	Y
95½	16⅛	56½	48	22¼	20¾	66¼	139⅝	17	90	60	6	17¼	136¾

REX SINGLE PUMPCRETE MODEL No. 180 & 200



	A	B	C	D	E	F	G	H	H1	J	K	L	L1	M	N	O	P	Q	R	S	T	U	V	V1	W	X	Z
Model 180..............	24	73½	46¾	31¾	37¾	34⅜	59½	102¾	81¼	8	48	151	158½	138	22⅞	126	67⅜	28¾	24	54½	69½	123¾	4⅜	8	51¾	22¾	60½
Model 200..............	24	73½	46¾	31¾	37¾	34⅜	59½	102¾	81¼	8	48	151	158½	138	23¾	126	67⅜	29¼	24	54½	69½	123¾	4⅜	8	51¾	22¾	60½

REX DOUBLE PUMPCRETE MODEL No. 160 & 200



	A	B	C	D	E	F	G	H	H1	J	K	L	L1	M	N	O	P	Q	R	S	T	U	V	W	X	Y
Model 160.......	66½	90	46¾	31¾	37¾	45¾	73¼	94½	66¼	8	48	151½	154¼	138	17	128¾	59	25⅜	24	54½	60	124¼	4⅜	....	17¼	30
Model 200........	75	105⅝	70¾	44	50½	64	88	104¾	83¼	8	48	153	158½	138	23¾	126	67½	29¼	24	58½	69½	123¾	6½	53¾	24¾	36

REX 160 SINGLE PUMPCRETE

Capacity cubic yards per hour.......................15 to 20
Bore of Cylinder.......................6.3″
Stroke of Piston.......................12″
R. P. M. (Approximate).......................50
POWER
4-Cylinder Gasoline Engine.......................25-30 h.p.
Electric Motor.......................20 h.p.

Hopper Capacity—Conical Hopper.......................¾ cu. yd.
Weight Equipped with Conical Hopper and Gasoline Engine.......................5,600 lbs.
Weight Equipped with Remixing Hopper
With Gasoline Engine.......................6600 lbs.
With Electric Motor.......................6800 lbs.

REX 160 DOUBLE PUMPCRETE

Capacity cubic yards per hour.......................30 to 40
Bore of Cylinder.......................6.3″
Stroke of Piston.......................12″
R. P. M. (Approximate).......................50
POWER
6 Cylinder Gasoline Engine.......................35-40 H. P.

Electric Motor.......................30 H. P.
Hopper Capacity—Remixing Hopper.......................2 Cu. Yds.
Weight Equipped with Remixing Hopper and Electric Motor.......................14850 Lbs.
Weight Equipped with Remixing Hopper and Gasoline Engine.......................14625 Lbs.

REX 180 SINGLE PUMPCRETE

Capacity cubic yards per hour.......................20 to 27
Bore of Cylinder.......................7.1″
Stroke of Piston.......................12″
R. P. M. (Approximate).......................50

POWER
4-Cylinder Gasoline Engine.......................30-35 h.p.
Electric motor.......................25 h.p.
Hopper Capacity—Conical Hopper.......................1¼ cu. yds.
Remixing Hopper.......................2 cu. yds.
Rotary Remixer.......................1½ cu. yds.

Weight equipped with Conical Hopper, Gas Engine Drive, no mounting.......................9,100 lbs.
Weight equipped with Conical Hopper, Electric Motor Drive, no mounting.......................9,600 lbs.
Weight equipped with Remixing Hopper, Gas Engine Drive, no mounting.......................13,100 lbs.
Weight equipped with Electric Motor Drive, no mounting.......................13,400 lbs.
Weight equipped with Rotary Mixer, Gas Engine Drive, no mounting.......................11,950 lbs.
Weight of Wheel Mounting (4 wheels—front and rear axles and towing tongue)..900 lbs.
Weight of Skid Mounting.......................500 lbs.

REX 200 SINGLE PUMPCRETE

Capacity cubic yards per hour.......................25 to 33
Bore of Cylinder.......................7.9″
Stroke of Piston.......................12″
R. P. M. (Approximate).......................50

POWER
6-Cylinder Gasoline Engine.......................35-40 h.p.
Electric Motor.......................30 h.p.
Hopper Capacity—Conical Hopper.......................1¼ cu. yds.
Remixing Hopper.......................2 cu. yds.
Rotary Remixer.......................1½ cu. yds.

Weight equipped with Conical Hopper, Gas Engine Drive, no mounting.......................9,700 lbs.
Weight equipped with Conical Hopper, Electric Motor Drive, no mounting.......................10,000 lbs.
Weight equipped with Remixing Hopper, Gas Engine Drive, no mounting.......................13,650 lbs.
Weight equipped with Remixing Hopper, Electric Motor Drive, no mounting.......................13,800 lbs.
Weight equipped with Rotary Remixer, Gas Engine Drive, no mounting.......................12,550 lbs.
Weight of Wheel Mounting (4 steel wheels, rear and front axle and towing tongue).......................900 lbs.
Weight of Skid Mounting.......................500 lbs.

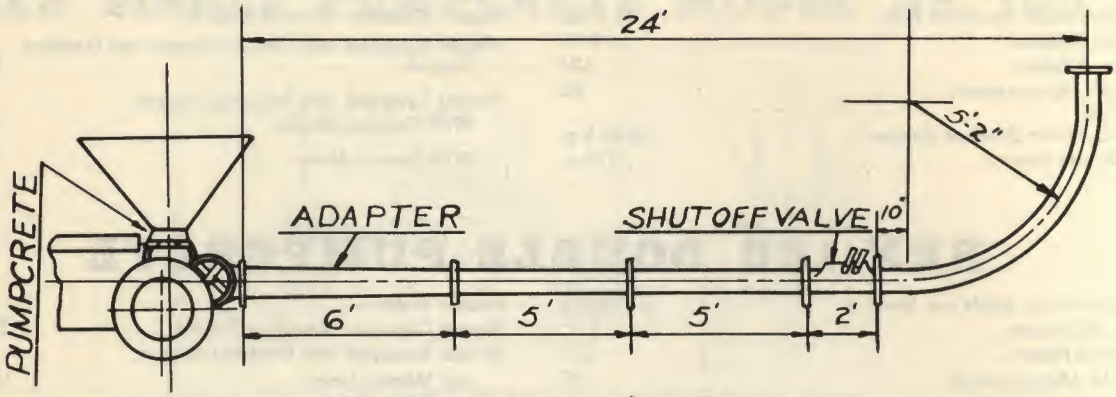
REX 200 DOUBLE PUMPCRETE

Capacity cubic yards per hour.......................50 to 65
Bore of Cylinder.......................7.9″
Stroke of Piston.......................12″
R. P. M. (Approximate).......................50

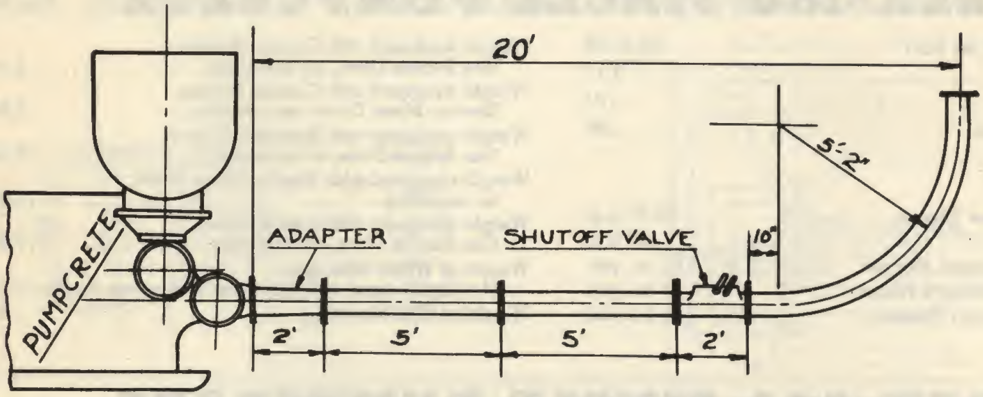
POWER
6-Cylinder Gasoline Engine.......................50-55 h.p.
Electric Motor.......................50 h.p.
Hopper Capacity—Conical Hopper.......................2 cu. yds.
Remixing Hopper.......................3 cu. yds.

Weight equipped with Conical Hopper, Gas Engine Drive, no mounting.......................17,550 lbs.
Weight equipped with Conical Hopper, Electric Motor Drive, no mounting.......................18,400 lbs.
Weight equipped with Remixing Hopper, Gas Engine Drive, no mounting.......................22,800 lbs.
Weight equipped with Remixing Hopper, Electric Motor Drive, no mounting.......................23,600 lbs.
Weight of Skid Mounting.......................650 lbs.

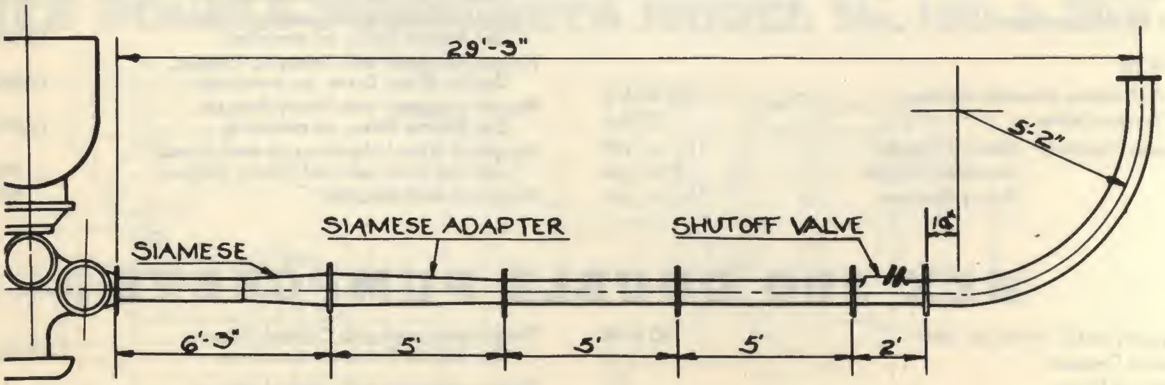
RECOMMENDED PIPE LINE INSTALLATION AT PUMPCRETE FOR GREATEST CONVENIENCE IN USING GO-DEVIL



160 PUMPCRETE 6" PIPE LINE



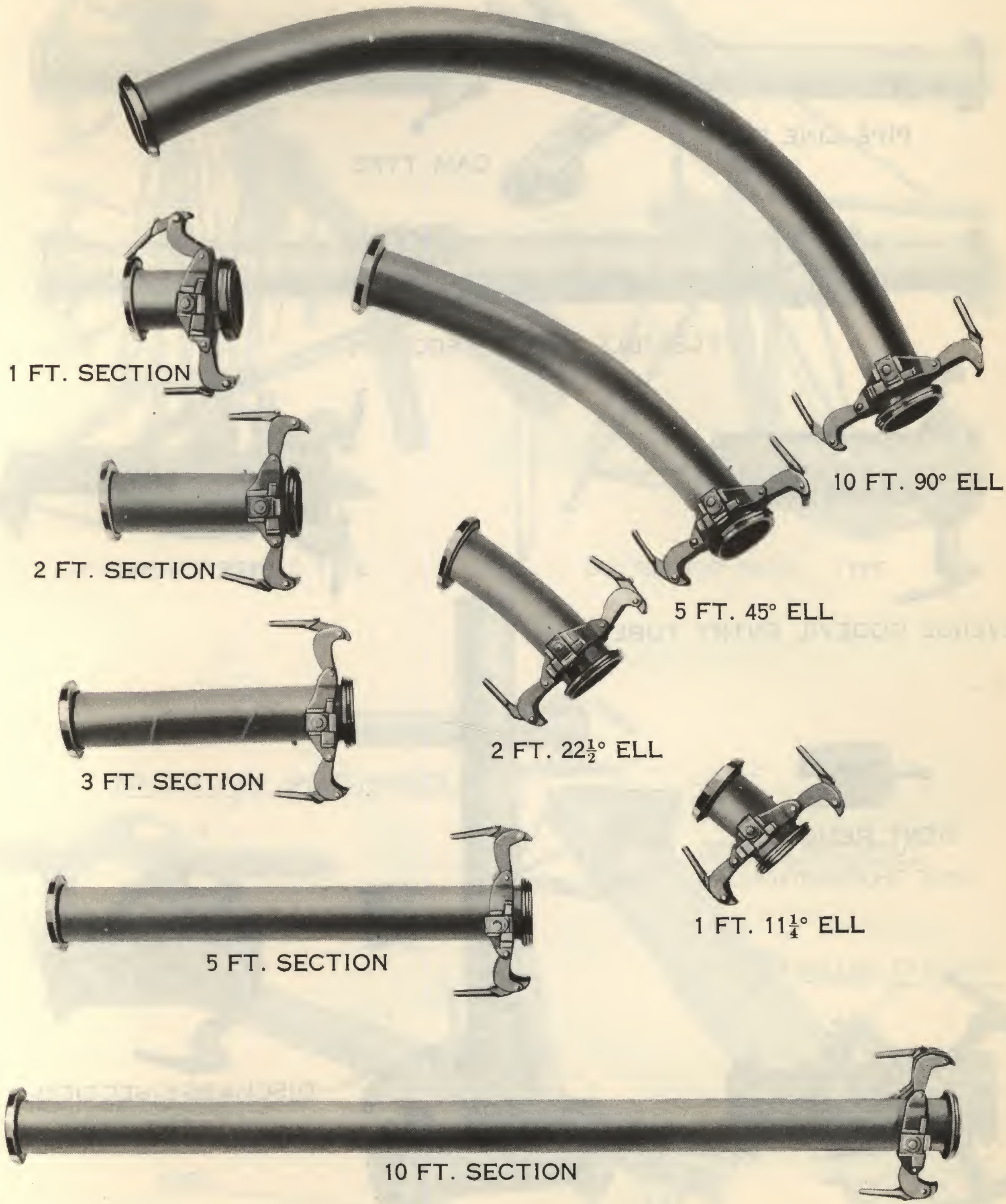
180 & 200 SINGLE PUMPCRETE 7" PIPE LINE



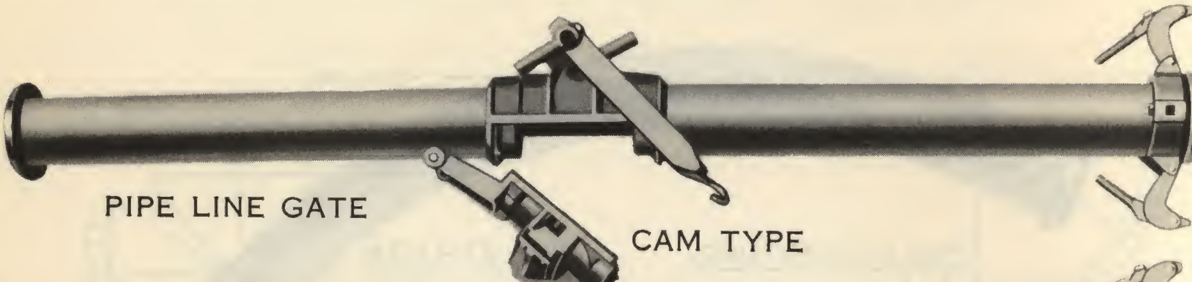
200 DOUBLE PUMPCRETE 7" PIPE LINE

SHUTOFF VALVE USED FOR VERTICAL PUMPING, MAY BE OMITTED FOR HORIZONTAL PUMPING

STANDARD PIPE LINE SECTIONS

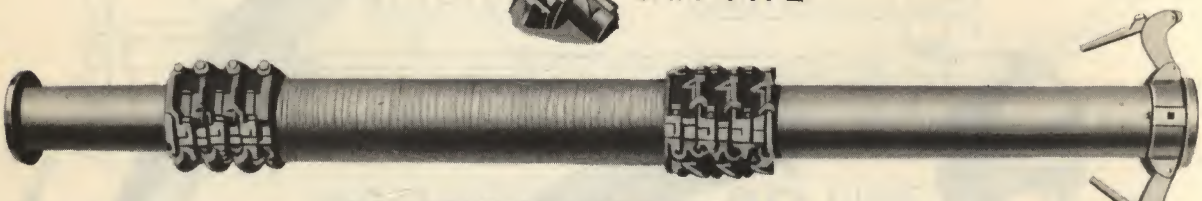


SPECIAL PIPE LINE SECTIONS

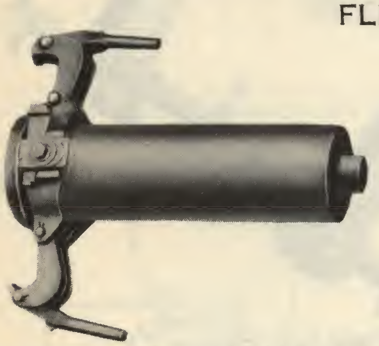


PIPE LINE GATE

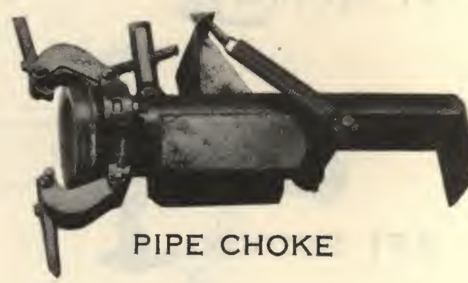
CAM TYPE



FLEXIBLE 10 FOOT SECTION

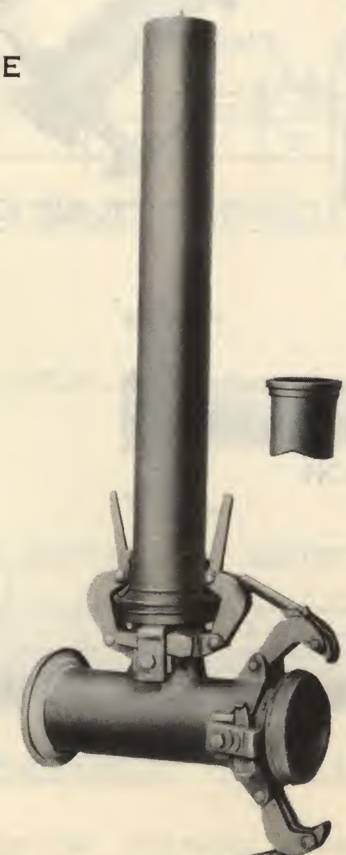


REVERSE GODEVIL ENTRY TUBE



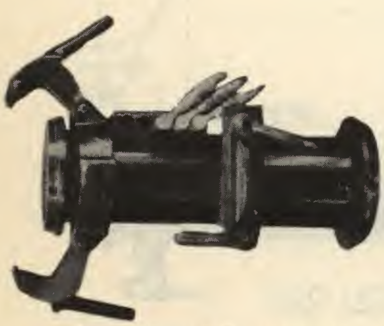
PIPE CHOKE

DENT REMOVER



AIRDOME ASSEMBLY

DISCHARGE SECTION

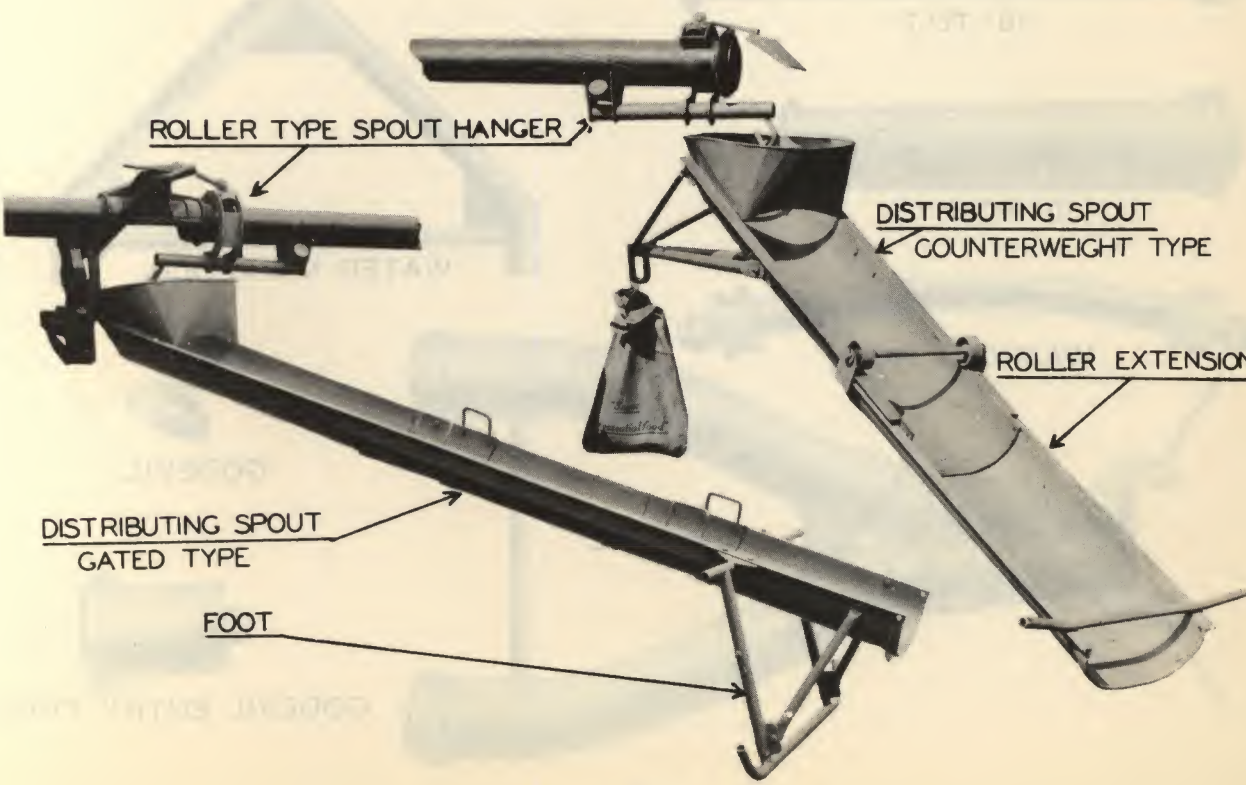


SHUT OFF VALVE

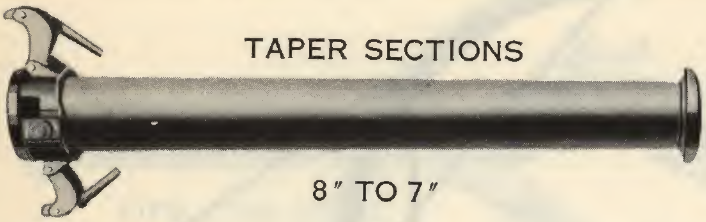
CONCRETE DISTRIBUTORS


DISTRIBUTOR-CHUTE TYPE

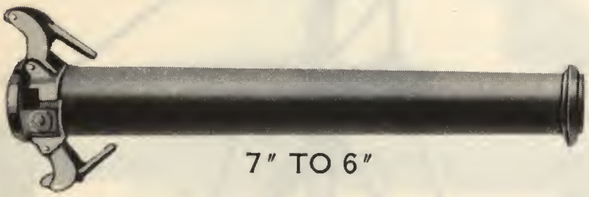

DISTRIBUTOR-SWIVEL TYPE



TAPER SECTIONS

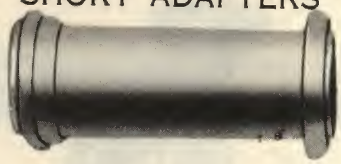


8″ TO 7″



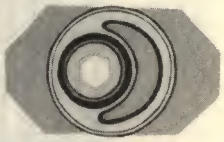
7″ TO 6″

SHORT ADAPTERS



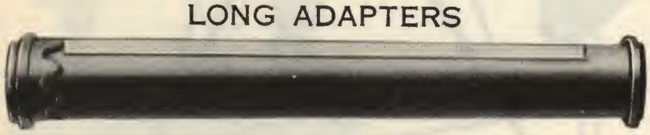
No. 160 TO 7″ No. 180 TO 8″
No. 180 TO 7″ No. 200 TO 8″

INLET WATER VALVE

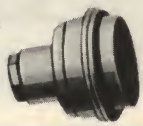


FOR NO. 160,
NO. 180, NO. 200

LONG ADAPTERS

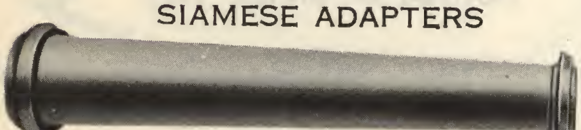


No. 160 TO 6″ No. 180 TO 6″
No. 200 TO 7″

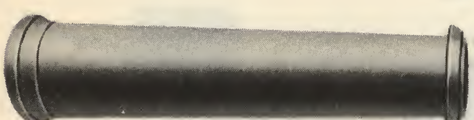


OUTLET WATER VALVE

SIAMESE ADAPTERS

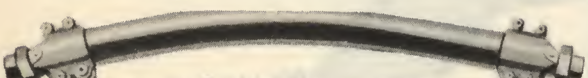


10″ TO 7″

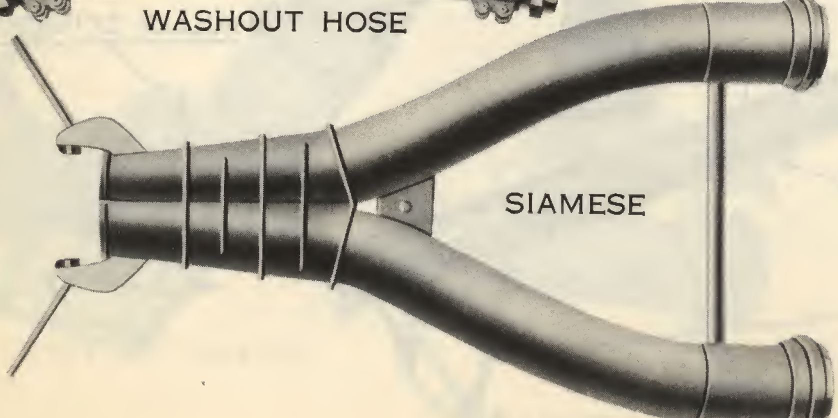


10″ TO 8″

WATER MANIFOLD

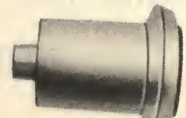


WASHOUT HOSE



SIAMESE

GODEVIL



GODEVIL ENTRY TUBE

MEMORANDA

MEMORANDA

MEMORANDA